

Del Valle Health and Wellness Center
Central Health
Del Valle, Texas

Project Manual

Volume 1 of 2



O'CONNELL ROBERTSON

Project Number: 2070.00

08.13.21

Del Valle Health and Wellness Center
Central Health
Del Valle, Texas

Project Manual

Volume 2 of 2



O'CONNELL ROBERTSON

Project Number: 2070.00

08.13.21

SECTION 00 01 07

SEALS PAGE

ARCHITECT OF RECORD

O'Connell Robertson
811 Barton Springs Road, Suite 900
Austin, Texas 78704



8/9/2021

Architect of Record

Date

MECHANICAL ENGINEER OF RECORD

O'Connell Robertson
811 Barton Springs Road, Suite 900
Austin, Texas 78704
TBPE Registered Firm No. F-2708



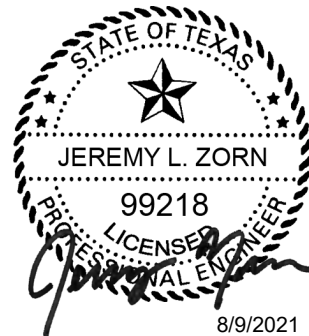
08/09/2021

Mechanical Engineer of Record

Date

ELECTRICAL ENGINEER OF RECORD

O'Connell Robertson
811 Barton Springs Road, Suite 900
Austin, Texas 78704
TBPE Registered Firm No. F-2708



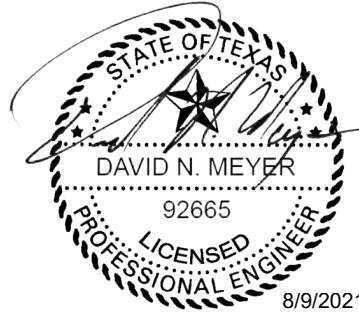
8/9/2021

Electrical Engineer of Record

Date

PLUMBING ENGINEER OF RECORD

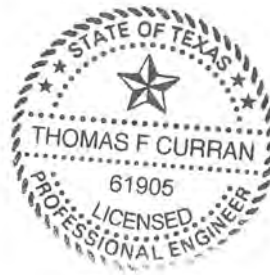
O'Connell Robertson
811 Barton Springs Road, Suite 900
Austin, Texas 78704
TBPE Registered Firm No. F-2708



Plumbing Engineer of Record Date

CIVIL ENGINEER OF RECORD

Doucet Associates
7401B Hwy 71 West, Suite 160
Austin, Texas 78735
TBPE Registered Firm No. F-3937





Civil Engineer of Record 08/12/2021
Date

STRUCTURAL ENGINEER OF RECORD

Structures
4408 Burnet Rd
Austin, Texas 78756
TBPE Registered Firm No. F-3323





Structural Engineer of Record 08/12/2021
Date

IT CONSULTANT OF RECORD

Datacom Consultant
7600 Burnet Rd, Suite 350
Austin, Texas 78757



IT Consultant of Record

Date

LANDSCAPE ARCHITECT OF RECORD

Coleman & Associates
9890 Silver Mountain Dr,
Austin, Texas 78737



Landscape Architect of Record

Date

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TRAVIS COUNTY HEALTHCARE DISTRICT

1111 E. Cesar Chavez Street, Suite B

Austin, Texas 78702

September 17, 2021 2:00PM CST

CSP 2108-002 General Contractor for Del Valle Health & Wellness Center

The Travis County Healthcare District (“TCHD” or “District”) invites qualified entities to submit proposals to provide *CSP 2108-002 General Contractor for Del Valle Health & Wellness Center*. Sealed Proposals will be received until 2:00 p.m. Central Time, on *September 17, 2021* by the Travis County Healthcare District, 1111 East Cesar Chavez, Suite B, Austin, TX 78702.

TCHD reserves the right to reject any and /or all proposals, to award contracts for individual products or services as may appear advantageous and to negotiate separately in any manner necessary to serve its best interests.

If not submitted electronically via www.bidsync.com, proposals delivered to TCHD locations other than Suite B will not be considered “received” until they arrive in Suite B. TCHD will not be responsible for delays in delivery resulting from need to transport a bid from another location or error or delay on the part of any carrier. **Proposals received at the designated location after the published time and date cannot be considered.**

No proposals may be withdrawn for a period of sixty (60) days subsequent to the deadline for receipt of proposals without the prior written consent of the Travis County Healthcare District.

There is no express or implied obligation for the District to reimburse entities or individuals for any expense incurred in preparing proposals in response to this request, and the District will not reimburse anyone for these expenses. The District will consider proposals from all responsible entities and/or individuals.

Unless accepted through Bidsync, proposals submitted by electronic transmission will not be considered; however, proposals may be modified by electronic transmission if the notice is received prior to the time and date set for the proposal opening and specific information is not exposed by the amendment.

Travis County Healthcare District d/b/a Central Health

Competitive Sealed Proposal

CSP 2108-002 General Contractor for Del Valle Health & Wellness Center



**CENTRAL
HEALTH**

August 16, 2021

Contact: Christina Irvin, Senior Purchasing Analyst
1111 E. Cesar Chavez St. Austin, TX 78702
Phone: 512-978-8003
Email: purchasing@centralhealth.net

PROPOSALS DUE: Friday, September 17, 2021 - 2:00 P.M. Prevailing Central Time

**Competitive Sealed Proposal
2108-001 General Contractor for Del Valle HWC
Procurement Schedule**

Action	Date	Time	Responsibility	Location / Details
Solicitation Issue Date	Monday, August 16, 2021	5:00 PM	Central Health	BidSync and Central Health Website
Site Visit (if applicable)	N/A	N/A	Central Health	N/A
Pre-Proposal Conference	Monday, August 23, 2021	2:30 PM	Central Health	https://meetings.ringcentral.com/j/1487159894
Question Submittal	Monday, August 30, 2021	5:00 PM	Proposers	BidSync or purchasing@centralhealth.net
Question Response	Tuesday, September 7, 2021	5:00 PM	Proposers	BidSync
Proposal Submission	Friday, September 17, 2021	2:00 PM	Proposers	BidSync or 1111 E. Cesar Chavez, Austin TX 78702
Proposal Opening	Friday, September 17, 2021	3:00 PM	Central Health	Bidsync

Proposals received after the Proposal Submission time at the designated location will not be considered.

Initial Contract Duration: Through Project Completion
 Estimated Completion Date: 12 months from NTP
 Estimated Construction Budget: \$9,180,000.00
 Proposals and Prices Good for: 60 days

PROPOSAL INSTRUCTIONS

Proposers should note that this Competitive Sealed Proposal (CSP) is published and accessible through electronic means. Proposers who received notification of this solicitation by means other than through any of the three websites listed below should register with BidSync in order to receive timely notification of any addenda, amendment, and/or other forms of information that may be issued prior to the solicitation submittal date:

<http://www.centralhealth.net/finance/purchasing>

<http://www.txsmartbuy.com/sp>

<https://prod.bidsync.com/central-health>

Registration is **free**.

Proposers are being given the option to submit an electronic proposal via BidSync or deliver a printed Proposal. In the event a proposer provides an electronic and a printed proposal, the electronic BidSync Proposal will be the proposal of record and will be used for the purposes of the CSP. **Proposals submitted in a format other than 1) online via BidSync or 2) delivery of a sealed printed proposal to the address below, will not be considered.**

Proposers who choose to deliver one (1) printed and sealed Proposal are asked to deliver via USPS mail, FedEx, DHL, etc.

DUE TO COVID-19 AND CURRENT BUILDING ACCESS RESTRICTIONS, YOU MUST CONTACT THE PROCUREMENT AUTHORITY PRIOR TO DELIVERY OF A PRINTED COPY TO THE PURCHASING OFFICE. The printed Proposal, with any supporting and/or sample documentation, must be delivered in a sealed container that is labeled and addressed as follows:

Attn: CSP 2108-002 General Contractor Del Valle Health & Wellness Center
Central Health - Purchasing Office
Attn: Christina Irvin, Senior Purchasing Analyst
1111 East Cesar Chavez Street
Austin, TX 78702

It is the Proposer's sole responsibility to ensure that it obtains any and all addenda and/or amendments to this CSP; addenda and amendments will be posted on the Bidsync website the day they are released. In the event of a conflict between a version of the CSP in the Proposer's possession and the version maintained by Central Health, the version maintained by Central Health will control.

All Proposals will be submitted and/or delivered on or before the closing date and time for receipt of Proposals. **Proposals received at the designated location after the published time and date will not be considered.**

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Exhibit F: Certificate of Secretary	Attached
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Exhibit I: Certificate of Interested Parties	Attached
Exhibit J: Not Used	N/A
Exhibit K: Insurance Coverage	Attached
Exhibit L: Not Used	N/A

I. INTRODUCTION

A. Entity Background

The Travis County Healthcare District d/b/a Central Health (“Central Health”) is a special purpose district created under Chapter 281 of the Texas Health and Safety Code that is responsible for providing hospital and medical care to the indigent and needy residents of Travis County. Together with its affiliates, the Community Care Collaborative, Sendero Health Plans, Inc., and Central Texas Community Health Centers d/b/a CommUnityCare (all four entities collectively, “TCHD Entities”), Central Health ensures low-income and uninsured residents receive timely access to quality health care services.

B. Purpose of Request for Proposals/Project Scope

Central Health seeks to obtain Proposals from qualified General Contractors. The project scope includes the new construction of a building and related site work for the Del Valle Health & Wellness Center. The project consists of a community health center on a 2.5-acre site in Southeast Travis County, 7050 Elroy Rd, Del Valle, TX 78617.

The new facility is a one-story building with 18,904 GSF. The facility will house a comprehensive primary care and dental care clinic and include a Class A Pharmacy with drive thru. A portion of the facility, roughly 1,700 sf, will remain shell space for future fit out. The project includes additional site amenities like a community gathering space and community garden.

The owner will supply all furniture, fixtures, and equipment through other vendors.

C. Procurement Authority

Central Health has designated a Procurement Authority who is responsible for the conduct of this procurement on behalf of Central Health; therefore, all deliveries (including Proposal delivery) shall be addressed as follows:

CSP 2108-002 General Contractor for Del Valle Health & Wellness Center

Central Health – Purchasing Office

Attn: Christina Irvin, Senior Purchasing Analyst

1111 East Cesar Chavez Street Austin, TX 78702

purchasing@centralhealth.net

Any inquiries or requests regarding this procurement should be submitted to the Procurement Authority as identified on BidSync and Central Health’s Website:

<http://www.centralhealth.net/finance/purchasing>. Proposers shall ONLY contact the Procurement Authority regarding this procurement. Proposers shall NOT contact individual Central Health Board Members, Central Health executive team leaders or staff regarding this solicitation. Such contact shall result in disqualification of the Proposer initiating the contact.

D. Definition of Terminology

This section contains definitions and abbreviations that are used throughout this procurement document.

"BAFO" request for a Best and Final Offer.

"BidSync Website" is the following link:

<https://prod.bidsync.com/central-health>

"Central Health Website" is the following link:

<http://www.centralhealth.net/finance/purchasing>.

"Close of Business (COB)" means 5:00 PM Prevailing Central Time.

"Competitive Sealed Proposal" or "CSP" means this request for submission of competitive sealed proposals, including all associated documents, Attachments, and Exhibits, which are hereby incorporated by reference and considered a part of the Proposals. The term may also refer to the competitive sealed proposals (see "Proposal" below) submitted by proposers in response to this request.

"Contract" means a written agreement for the procurement of items of tangible personal property or services, or both.

"Determination" means the written documentation of a decision by the Procurement Authority, including findings of fact supporting a decision. A Determination becomes part of the procurement file.

"Desirable" means that the terms "may", "can", "preferably", or "prefers" identify a Desirable or discretionary item or factor (as opposed to "Mandatory").

"Duly Authorized Representative" means the individual who is authorized to submit a Proposal to this CSP on behalf of Proposer and to bind the Proposer to any Contract that may result from the Submission of Proposal.

"ESBD" is the following link: <http://www.txsmartbuy.com/sp>

"Evaluation Committee" means a body appointed by Central Health management to perform the evaluation of Proposals.

"Evaluation Committee Report" means a document prepared by the Procurement Authority and the Evaluation Committee for Contract/s award. It contains all written Determinations resulting from the CSP.

"Finalist" is defined as a Proposer who meets all the Mandatory specifications of this Request for Proposals and whose score on evaluation factors is sufficiently high to merit further consideration by the Evaluation Committee.

"Mandatory" means that the terms "must", "shall", "will", "is required", or "are required" identify a Mandatory item or factor (as opposed to "Desirable"). Failure to meet a Mandatory item or factor may result in the rejection of the Proposer's Proposal.

"Principal" is a person in charge of an organization who takes leadership.

"Proposer" is any person, entity, corporation, or partnership that submits a Proposal.

"Proposal" means a competitive sealed proposal submitted in response to this CSP.

"Procurement Authority" means a person or designee authorized by Central Health to manage or administer a procurement requiring the evaluation of the CSP Proposal.

"Responsible Proposer" means a Proposer who submits a Proposal and who has furnished, when required, information and data to prove that on the basis of demonstrated competence and qualifications, its financial resources, production and service facilities, personnel, service reputation and experience are adequate to satisfactorily perform the Services or provide items of tangible personal property described in the Proposal.

"Responsive Proposal" means a Proposal that includes all required documentation and conforms in all material respects to the requirements set forth in the Request for Proposals. The Proposal to this Request for Proposals must include responsive information, which support the Proposer's competence, qualifications, and ability to perform the Services, including, but not limited to, quality, quantity, and delivery requirements.

II. PROCUREMENT SCHEDULE

This section of the CSP describes all major events listed in the CSP Schedule. The Procurement Authority will make every effort to adhere to the Procurement Schedule set forth in this CSP.

A. Pre-proposal Conference

If a pre-proposal conference, the date and time of that event, will be noted in the Procurement Schedule on page 2 of this CSP and on the BidSync Website. Attendees' names and email contact information will be shared and posted on BidSync and the Central Health Website to facilitate possible subcontracting opportunities. In addition, any questions received and answered at this event will be posted on BidSync and the Central Health Website.

B. Deadline to Submit Questions

All Proposers are expected to carefully examine this CSP. Any ambiguities or inconsistencies therein should be brought to the attention of the Procurement Authority as described in this CSP. Additionally, it is the responsibility of the Proposer to obtain clarification of any information contained herein that is not fully understood. Proposers may submit written questions via BidSync.

C. Response to Written Questions

Written responses to all questions submitted by potential Proposers will be addressed in either a CSP addendum or question and answer document that will be posted on BidSync by Close of

Business per the Question Response Date as indicated in the Procurement Schedule on page 2 of this CSP.

Any verbal statement made by Central Health regarding the CSP prior to the award will be considered non-binding. The only formal interpretation of the CSP will be made by addendum or a question-and-answer document issued by the Procurement Authority.

D. Submission of Proposal

The Procurement Authority or designee must receive all proposals for review and evaluation no later than 2:00 PM Central Time per the Proposal Submission Date as indicated in the Procurement Schedule on page 2 of this CSP. Proposals received after this deadline will not be accepted. **Refer to Proposal Instructions on page 3 of this CSP for Proposal Submission instructions.**

Proposals submitted via Bidsync (preferred method), BidSync.com will automatically record the date and time of receipt of each correctly submitted Proposal.

The date and time of receipt will be recorded on each printed Proposal. The Proposal **must be addressed and delivered to the Procurement Authority in a sealed container at the address listed in 1.C above**. Proposals submitted by facsimile or other electronic means will not be accepted.

A public log will be kept of the names of all organizations that submit a Proposal. Unless required by law, the contents of any Proposal will not be disclosed to competing Proposers prior to Contract award.

E. Opening of Proposals

The Procurement Authority will publicly open all sealed proposals received by the submission deadline, as outlined in the Procurement Schedule, virtually, on the Date and Time indicated in the Procurement Schedule on page 2 of this CSP. For all proposals received by the deadline, the Procurement Authority will read aloud the names of the offerors and any monetary proposal made by the offerors. For Proposals submitted electronically, the names of the proposers will be available on the solicitation opening date immediately after the opening time at BidSync.com. Please note for hard copy responses the names of the proposers will be uploaded into BidSync.com and available to the public within four business hours of the opening date and time.

The Purchasing Offices strongly encourages proposers to download the names of the proposers from Bidsync.com or use the virtual dial-in information (supplied within the solicitation) where the names of the proposers will be listed for your information. We are strongly discouraging proposers from going to our office for the solicitation openings. At the opening, the proposals are opened in a manner that avoids disclosure of the contents to other proposers. They are kept secret until the contract is awarded. After the contract award, unless a proposer has identified parts of the proposal as trade secrets and confidential information in compliance with the Public Information Act, the contents of all proposals will be available and open for public inspection.

F. Proposal Evaluation

Bids shall be evaluated without discussions. The Evaluation Committee will evaluate, score, and rank written Proposals using the evaluation criteria identified in section XIV. A. EVALUATION CRITERIA.

G. Negotiations with Selected Offeror

Based on the scoring, the Purchasing Manager will attempt to negotiate a contract with the highest scoring offeror who the Evaluation Committee determines offers the best value. Central Health, and its architect or engineer may discuss with the selected offeror options for a scope or time modification and any price change associated with the modification. If Central Health is unable to negotiate a satisfactory contract with the selected offeror, the governmental entity shall, formally and in writing, end negotiations with that offeror and proceed to the next offeror in the order of the selection ranking until a contract is reached or all proposals are rejected.

H. Contract Award

Central Health may but is not obligated to award a Contract to the Proposer that best satisfies Central Health's requirements and provides the best overall value to Central Health for the Project.

As of the date of issuance, a single award is contemplated.

III. PROPOSER RIGHTS AND OBLIGATIONS

A. Rights

1. Amending Proposals

Any Proposer may submit an amended Proposal before the deadline for receipt of Proposals. Such amended Proposals must be complete replacements for a previously submitted Proposal and must be clearly identified as such in the transmittal letter. Central Health will not merge, collate, or assemble Proposal materials.

2. Withdrawing Proposals

Proposers will be allowed to withdraw their Proposals at any time prior to the deadline for receipt of Proposals. To withdraw a Proposal, the Proposer must submit a written withdrawal request signed by the Proposer's Duly Authorized Representative and addressed to the Procurement Authority.

3. Designating Proposal Contents as Confidential or Proprietary

Proposers may mark, stamp, or imprint the words "proprietary" or "confidential" on any pages of the Proposal that include information of this type. However, Proprietary or confidential information should be readily separable from the Proposal in order to facilitate eventual public inspection of the other portions of the Proposal. Central Health will not sort, otherwise isolate, or redact proprietary or confidential information embedded within the body of a Proposal.

B. Obligations

1. Conditions and Contract Terms Associated with CSP

Proposers must indicate their acceptance of all conditions governing the CSP in their letter of

transmittal. However, a Proposer's failure to do so will not operate to exempt Proposer from these conditions, as the act of submission itself constitutes acceptance of the conditions, including the evaluation criteria contained in section VI. B. EVALUATION CRITERIA of this CSP.

Additionally, Proposers must agree to include the terms contained within Exhibit G – Sample Contract with Required Contract Terms and Conditions, which is incorporated in this CSP, and in any Contract that results from this CSP.

2. Costs Associated with Procurement

Any and all costs incurred by the Proposer in preparation, transmittal, and presentation of any Proposal or material submitted in response to this CSP will be borne solely by the Proposer.

3. Electronic Mail Address

A large part of the communication regarding this procurement will be conducted by electronic mail (e-mail). Therefore, all Proposers must have a valid e-mail address to receive correspondence.

4. Identification and Selection of Subcontractors

The term "subcontractor" includes sub-consultants. Proposer's intended use of subcontractors must be clearly explained in its Proposals, and major subcontractors must be identified by name. The awarded Proposer will be wholly responsible for the entire performance of the Contract, whether or not subcontractors are used, and Proposer expressly acknowledges that in entering into such subcontract(s), Central Health is in no manner liable to any subcontractor(s). Awarded Proposer further acknowledges that Central Health will make Contract payments only to the awarded Proposer.

5. Historically Underutilized Business (HUB) Program and Good Faith Effort

Proposers will be required to make a "good faith effort" to take all necessary and reasonable steps to ensure that certified HUBs (see next paragraph) have the maximum opportunity to participate in the performance of any Contract that results from this CSP as subcontractors. An awarded Proposer's failure to carry out this "good faith effort" will constitute a breach of Contract and may result in termination of the Contract.

HUB contractors and subcontractors must be certified as a HUB, Minority/Women-Owned Business Enterprises, or Disadvantaged Business Enterprise source by a recognized governmental program, such as:

- City of Austin Municipal Government;
- Texas Unified Certification Program; or
- State of Texas; or
- Other certification entity recognized by Travis County, Texas

Any subcontractor who Proposer intends to subcontract with at the time of Proposal submission and that is identified as a HUB, will be required to submit a copy of its certification with this Proposal. Central Health reserves the right to verify any entity's HUB status prior to

Contract award.

6. Suspension and Debarment Certification

The Proposer will certify, by signing the Acknowledgement of Receipt Form, attached hereto as Exhibit C, that to the best of its knowledge and belief that the Proposer and/or its Principals or subcontractors are not and have not been debarred, suspended, proposed for debarment, or declared ineligible for the award of Contracts by any federal department or district.

7. Conflict-of-Interest Questionnaire (CIQ Form)

Pursuant to Chapter 176 of the Texas Local Government Code, the awarded Proposer, if any, will be required to complete the Conflict-of-Interest Questionnaire ("CIQ"), which is attached to this CSP as Exhibit E, and submit it together with the Contract, if the Proposer has: (i) an employment or other business relationship with a local government officer of Central Health or a family member of same; (ii) given a local government officer of Central Health or a family member of same one or more gifts having an aggregate value as specified in Exhibit E or (iii) has a family relationship with a local government officer of Central Health. For additional information concerning filling out the CIQ, see with <https://www.ethics.state.tx.us/forms/conflict/>

8. Certificate of Interested Parties (Form 1295)

Section 2252.908 of the Texas Government Code prohibits a governmental entity, like Central Health, from entering into certain Contracts, unless the business entity submits a Certificate of Interested Parties form, attached to this CSP as EXHIBIT I, to the governmental entity at the time the business entity executes a Contract. Form 1295 is applicable to any of awarded Proposer's directors, officers, or employees who hold a controlling interest (10% or more ownership) in the business entity and who actively participated in facilitating the Contract or negotiating the terms of same (broker, intermediary, advisor, and/or attorney), if any.

Selected Offeror will be required to electronically file a Form 1295 with the Texas Ethics Commission upon notification of selection from Central Health. The online filing process will generate a Certificate Number and Date Filed. Selected Offeror will submit that information Central Health as part of its contract.

For more information, visit:

<https://www.ethics.state.tx.us/filinginfo/1295/>

9. Good-Faith Negotiations

The Procurement Authority or designee will participate in all discussions with Selected Offeror. Discussions will only be conducted with responsible Selected Offeror who submit Responsive Proposals to the CSP, which are determined to be reasonably acceptable of being selected for award. The Selected Offeror will be accorded fair and equal treatment with respect to any opportunity for discussion and revision of Proposals. The Selected Offeror may be required to submit additional information and/or clarify previously submitted information before negotiations commence. Revisions and supplements to Proposals may also be permitted after submission and before Contract award for the purpose of obtaining BAFOs in Central

Health's sole discretion. Any BAFO, as well as the entire Proposal, will become part of Central Health's awarded Contract.

Central Health reserves the right to negotiate the price and any other term with the Selected Offeror. Any oral negotiations must be confirmed in writing prior to an award.

10. Texas Workers' Compensation Coverage (TWCC)

The Texas Department of Insurance, Division of Workers' Compensation ("TDIDWC") has adopted Rule 110.110. Rule 110.110 applies to all building and construction contracts advertised for bid by a governmental entity on or after September 1, 1994. Rule 110.100, and any amendments thereto, affects your bid on this project.

- Rule 110.110 is designed to achieve compliance from contractors, subcontractors, and governmental entities regarding workers' compensation insurance coverage. This affects contractors, subcontractors, and the Central Health on this project.
- Providing false or misleading certificates of coverage, failing to provide or maintain required coverage, or failing to report any change that materially affects the coverage may subject the contractor(s) or other persons providing services on this project to administrative penalties, criminal penalties, civil penalties, or other civil actions. This affects contractors and subcontractors.
- Therefore, the following TDIDWC RULE 110.110 is provided in accordance with the requirements on governmental entities as set forth in Title 28, Part 2, Section 110.110(c) of the Texas Administrative Code. Please read this carefully and prepare your bid in full compliance with TDIDWC Rule 110.110. Failure to provide the required certificates upon submission of a bid could result in your bid being declared non-responsive.
- We do not believe that Rule 110.110 creates any additional duties or burdens on anyone which Texas workers' compensation laws, rules, and regulations have not already established. Therefore, the County should not experience any increase in cost because of the need to comply with all Texas workers' compensation laws, rules, and regulations.

Additional questions may be addressed to the Texas Department of Insurance, Division of Workers' Compensation Central Office, 7551 Metro Center Drive, Suite 100, Austin, Texas 78744, (512) 804-4000 or toll free at (800) 372-7713.

TDIDWC Rule 110.110 Workers' Compensation Insurance Coverage

A. Definitions:

Certificate of Coverage ("certificate") - A copy of a certificate of insurance, a certificate of authority to self-insure issued by the commission, or a coverage agreement (TWCC-81, TWCC-82, TWCC-83, or TWCC-84), showing statutory workers' compensation insurance coverage for the person's or entity's employees providing services on a project, for the duration of the project.

Duration of the project - includes the time from the beginning of the work on the project until the contractor's/person's work on the project has been completed and accepted by the

governmental entity.

Persons providing services on the project (“subcontractor” in §406.096) - includes all persons or entities performing all or part of the services the contractor has undertaken to perform on the project, regardless of whether that person contracted directly with the contractor and regardless of whether that person has employees. This includes, without limitation, independent contractors, subcontractors, leasing companies, motor carriers, owner-operators, employees of any such entity, or employees of any entity which furnishes persons to provide services on the project. “Services” include, without limitation, providing, hauling, or delivering equipment or materials, or providing labor, transportation, or other service related to a project. “Services” does not include activities unrelated to the project, such as food/beverage vendors, office supply deliveries, and delivery of portable toilets.

B. The contractor shall provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all employees of the contractor providing services on the project, for the duration of the project.

C. The Contractor must provide a certificate of coverage to the governmental entity prior to being awarded the contract.

D. If the coverage period shown on the contractor’s current certificate of coverage ends during the duration of the project, the contractor must, prior to the end of the coverage period, file a new certificate of coverage with the governmental entity showing that coverage has been extended.

E. The contractor shall obtain from each person providing services on a project, and provide to the governmental entity:

1. A certificate of coverage, prior to that person beginning work on the project, so the governmental entity will have on file certificates of coverage showing coverage for all persons providing services on the project; and
2. No later than seven days after receipt by the contractor, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project.

F. The contractor shall retain all required certificates of coverage for the duration of the project and for one year thereafter.

G. The contractor shall notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the contractor knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project.

H. The contractor shall post on each project site a notice, in the text, form and manner prescribed by the Texas Workers’ Compensation Commission, informing all persons providing services on the project that they are required to be covered, and stating how a person may

verify coverage and report lack of coverage.

- I.** The contractor shall contractually require each person with whom it contracts to provide services on a project, to:
1. Provide coverage, based on proper reporting of classification codes and payroll amounts and filing of any coverage agreements, which meets the statutory requirements of Texas Labor Code, Section 401.011(44) for all of its employees providing services on the project, for the duration of the project;
 2. Provide to the contractor, prior to that person beginning work on the project, a certificate of coverage showing that coverage is being provided for all employees of the person providing services on the project, for the duration of the project;
 3. Provide the contractor, prior to the end of the coverage period, a new certificate of coverage showing extension of coverage, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
 4. Obtain from each other person with whom it contracts, and provide to the contractor:
 - A certificate of coverage, prior to the other person beginning work on the project; and
 - A new certificate of coverage showing extension of coverage, prior to the end of the coverage period, if the coverage period shown on the current certificate of coverage ends during the duration of the project;
 5. Retain all required certificates of coverage on file for the duration of the project and for one year thereafter;
 6. Notify the governmental entity in writing by certified mail or personal delivery, within 10 days after the person knew or should have known, of any change that materially affects the provision of coverage of any person providing services on the project; and
 7. Contractually require each person with whom it contracts, to perform as required by paragraphs (1) - (7), with the certificates of coverage to be provided to the person for whom they are providing services.
- J.** By signing this contract or providing or causing to be provided a certificate of coverage, the contractor is representing to the governmental entity that all employees of the contractor who will provide services on the project will be covered by workers' compensation coverage for the duration of the project, that the coverage will be based on proper reporting of classification codes and payroll amounts, and that all coverage agreements will be filed with the appropriate insurance carrier or, in the case of a self-insured, with the commission's Division of Self-Insurance Regulation. Providing false or misleading information may subject the contractor to administrative penalties, criminal penalties, civil penalties, or other civil actions.
- K.** The contractor's failure to comply with any of these provisions is a breach of contract by the contractor which entitles the governmental entity to declare the contract void if the contractor does not remedy the breach within ten days after receipt of notice of breach from the governmental entity.

11. Prevailing Wage Rate Determination - Site Construction & Building Construction Crafts

NOTICE

The Central Health has adopted the prevailing wage rates for its Travis County projects as determined by the United States Department of Labor in accordance with the Davis –Bacon Act and its subsequent amendments. The prevailing wage rates for this project are those rates set forth for Travis County in the U.S. Department of Labor General Decisions for (1) Building Construction Projects or (2) Highway Construction Projects.

Copies of the appropriate U.S. Department of Labor General Decisions referenced above are included in this CSP.

This determination of prevailing wages will not be construed to prohibit the payment of more than the rate named. Under no condition will any laborer, workman, or mechanic employed on this job be paid less than the minimum wage scale.

The Contractor must comply with all applicable state and federal laws, including, but not limited to, laws concerned with labor, equal employment opportunity, safety, and minimum wage. The Contractor must post the applicable Prevailing Wage Rate Determination in a prominent, easily accessible place at the work site. To ensure that the Contractor, and/or subcontractors are paying the posted specified rates (including fringe benefits when applicable) to all classifications of workmen, mechanics, and laborers, the Central Health reserves the right to perform “spot labor interviews” and examine Contractor payroll information.

Pursuant to Chapter 2258 of the Texas Government Code:

- A worker employed on a public work by or on behalf of Central Health must be paid:
 - Not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed; and
 - Not less than the general prevailing rate of per diem wages for legal holiday and overtime work. NOTE: This Paragraph Number 1 does not apply to maintenance work.
- A worker is employed on a public work for the purposes of Paragraph Number 1 if the worker is employed by a contractor or subcontractor in the execution of a contract for the public work with Central Health or any officer or department of Central Health.
- The contractor who is awarded a contract by the Central Health, or a subcontractor of the contractor, must pay not less than the rates (plus fringe benefits when applicable) as listed in the U.S. Department of Labor General Decisions referenced above to a worker employed by the contractor to work on the project.
- A contractor or subcontractor who violates this section must pay to the Central Health \$60 for each worker employed for each calendar day or part of the day that the worker is paid less than the wage rates set forth in the U.S. Department of Labor General Decisions referenced above. Subject to a final determination of the matter, Central Health may use any money collected pursuant to this section to offset the cost incurred in the administration of the requirements of Chapter 2258.
- Central Health will take notice of complaints of all violations of this chapter committed in the execution of the contract and withhold money or required to be withheld under

Chapter 2258 from the payments to the contractor under the contract, except that the Central Health may not withhold money from other than the final payment without a determination by the Central Health that there is good cause to believe that the contractor has violated this chapter.

- The contractor will post the following notices and the wage rates prominently at the Project.

WAGE SCHEDULE

"General Decision Number: TX20210271 07/09/2021

Superseded General Decision Number: TX20200271

State: Texas

Construction Type: Building

County: Travis County in Texas.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Under Executive Order (EO) 13658, an hourly minimum wage of \$10.95 for calendar year 2021 applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2015. If this contract is covered by the EO, the contractor must pay all workers in any classification listed on this wage determination at least \$10.95 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in calendar year 2021. If this contract is covered by the EO and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must pay workers in that classification at least the wage rate determined through the conformance process set forth in 29 CFR 5.5(a)(1)(ii) (or the EO minimum wage rate, if it is higher than the conformed wage rate). The EO minimum wage rate will be adjusted annually. Please note that this EO applies to the above-mentioned types of contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but it does not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60). Additional information on contractor requirements and worker protections under the EO is available

at <https://protect-us.mimecast.com/s/-O2FC820wAcNNE2szJeIs?domain=dol.gov>.

Modification Number Publication Date

0 01/01/2021
1 03/12/2021
2 05/07/2021
3 07/09/2021

ASBE0087-014 03/02/2020

Rates Fringes

ASBESTOS WORKER/HEAT & FROST
INSULATOR (Duct, Pipe and
Mechanical System Insulation)....\$ 23.97 10.79

BOIL0074-003 01/01/2017

Rates Fringes

BOILERMAKER.....\$ 28.00 22.35

CARP1266-002 04/01/2017

Rates Fringes

CARPENTER (Excludes
Acoustical Ceiling
Installation, Drywall
Hanging, Form Work, and Metal
Stud Installation).....\$ 21.96 7.90

ELEC0520-005 01/01/2020

Rates Fringes

ELECTRICIAN
Excludes Installation of
Sound and Communication
Systems.....\$ 29.44 11%+5.73
Low Voltage Wiring Only.....\$ 29.44 11%+5.73

ELEV0133-002 01/01/2021

Rates Fringes

ELEVATOR MECHANIC.....\$ 43.72 36.365

Footnote:

A. 6% under 5 years based on regular hourly rate for all
hours worked. 8% over 5 years based on regular hourly rate
for all hours worked.

B. Holidays: New Year's Day, Memorial Day, Independence Day,
Labor Day, Thanksgiving Day, the Friday after Thanksgiving
Day, Christmas Day, and Veterans Day.

ENGI0450-002 04/01/2014

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
Cranes.....	\$ 34.85	9.85

IRON0084-011 06/01/2020		
	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 25.26	7.13

* PLUM0286-010 06/07/2021		
	Rates	Fringes
PIPEFITTER (Including HVAC		
Pipe Installation).....	\$ 32.05	14.92

SFTX0669-002 04/01/2021		
	Rates	Fringes
SPRINKLER FITTER (Fire		
Sprinklers).....	\$ 31.68	22.50

SHEE0067-007 04/01/2021		
	Rates	Fringes
SHEET METAL WORKER		
Excludes HVAC Duct		
Installation.....	\$ 27.58	15.76
HVAC Duct Installation Only.....	\$ 27.58	15.76

SUTX2014-049 07/21/2014		
	Rates	Fringes
BRICKLAYER.....	\$ 20.07	0.00
CARPENTER (Acoustical Ceiling		
Installation Only).....	\$ 14.00	0.00
CARPENTER (Form Work Only).....	\$ 15.62	0.05
CEMENT MASON/CONCRETE FINISHER.....	\$ 15.71	0.00
DRYWALL FINISHER/TAPER.....	\$ 17.06	4.43
DRYWALL HANGER AND METAL STUD		
INSTALLER.....	\$ 17.47	3.45
ELECTRICAL INSTALLER (Sound		
and Communication Systems)		
(Excludes Wiring).....	\$ 18.00	2.30
FLOOR LAYER: Carpet.....	\$ 21.88	0.00
GLAZIER.....	\$ 12.83	0.00

HVAC MECHANIC (HVAC Unit Installation Only).....	\$ 23.78	6.89
IRONWORKER, REINFORCING.....	\$ 12.27	0.00
IRONWORKER, STRUCTURAL.....	\$ 20.73	5.24
LABORER: Common or General.....	\$ 11.44	0.00
LABORER: Mason Tender – Brick.....	\$ 12.22	0.00
LABORER: Mason Tender - Cement/Concrete.....	\$ 11.85	0.00
LABORER: Pipelayer.....	\$ 12.45	0.00
LABORER: Roof Tearoff.....	\$ 11.28	0.00
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 19.43	3.49
OPERATOR: Bobcat/Skid Steer/Skid Loader.....	\$ 13.00	0.00
OPERATOR: Bulldozer.....	\$ 14.00	0.00
OPERATOR: Drill.....	\$ 14.50	0.00
OPERATOR: Forklift.....	\$ 16.64	6.26
OPERATOR: Grader/Blade.....	\$ 19.30	0.00
OPERATOR: Loader.....	\$ 14.00	0.00
OPERATOR: Mechanic.....	\$ 18.75	5.12
OPERATOR: Paver (Asphalt, Aggregate, and Concrete).....	\$ 16.03	0.00
OPERATOR: Roller.....	\$ 11.25	0.00
PAINTER (Brush, Roller and Spray), Excludes Drywall Finishing/Taping.....	\$ 18.76	6.35
PLUMBER, Excludes HVAC Pipe Installation.....	\$ 23.57	6.37
ROOFER.....	\$ 12.00	0.00
TILE FINISHER.....	\$ 11.32	0.00
TILE SETTER.....	\$ 16.35	0.00
TRUCK DRIVER: Dump Truck.....	\$ 12.39	1.18
TRUCK DRIVER: Flatbed Truck.....	\$ 19.65	8.57
TRUCK DRIVER: Semi-Trailer Truck.....	\$ 12.50	0.00

TRUCK DRIVER: Water Truck.....\$ 12.00	4.11
WATERPROOFER.....\$ 16.30	0.06

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://protect-us.mimecast.com/s/-O2FC820wAcNNE2szJeIs?domain=dol.gov>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010

08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an

interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION"

IMPORTANT INFORMATION

YOU CAN DIRECT ANY WAGE DISPUTES OR QUESTIONS TO:

**Central Health Purchasing Office
1111 E. Cesar Chavez Street
Austin, TX 78702
512-580-8003**

Pursuant to Section 2258.023(a) of the Government Code, "The contractor who is awarded a contract by a public body or a subcontractor of the contractor must pay not less than the rates determined under Section 2258.022 to a worker employed by it in the execution of the contract."

INFORMACION IMPORTANTE

TU PUEDES DISCUTIR O PREGUNTAR DE TU SALARIO DIRECTAMENTE CON:

**OFICINA DE COMPRAS DE CENTRAL HEALTH
1111 E. Cesar Chavez Street
Austin, TX 78702
512-580-8003**

De acuerdo con la seccion 2258.023(a) delCodigo del Gobierno, "El contratista al que le fue adjudicado un contrato por el Gobierno, o su subcontratista, debaran pagar a un trabajador contratado, no menos que las tarifas determinadas bajo la seccion 2258.022, para la ejecucion del contrato."

IV. CENTRAL HEALTH RIGHTS

A. Summary of Rights

Central Health may:

1. Reject any or all Proposals without obligation or liability to any Proposer;
2. Accept a Proposal other than the lowest-price Proposal (as applicable);
3. Award a Contract on the basis of an initial Proposal received without discussions or requests for Best and Final Offers;
4. Request Best and Final Offers from Selected Offeror;
5. Procure the Services in whole or in part by other means;
6. Award a Contract; and/or
7. Not award any Contract.

V. Termination of CSP

This CSP may be canceled at any time and any and all Proposals may be rejected in whole or in part if Central Health determines such action to be in Central Health's best interest.

VI. Waive Minor Irregularities

The Evaluation Committee reserves the right to waive minor irregularities (e.g. Proposer submits the incorrect number of Proposal copies or does not sign all Proposal copies) in the Proposals. The Evaluation Committee also reserves the right to waive certain, non-mandatory requirements contained herein if the Proposal otherwise meets the mandatory requirements and/or waiving the minor irregularity does not otherwise materially affect the procurement. This right may be exercised at the Evaluation Committee's sole discretion.

VII. CSP Amendments

Central Health reserves the right to issue amendments to this CSP before the date on which Proposals are due. Amendments will be posted on the Bidsync website.

VIII. Negotiate Additional Contract Terms

Central Health reserves the right to modify and negotiate with a successful Proposer provisions in addition to those attached to this CSP. The contents of this CSP, as revised and/or supplemented, and any portions of the successful Proposer's Proposal acceptable to Central Health, will be incorporated into and become part of the Contract.

IX. Accept Contract Deviations

Any additional terms and conditions, which may be the subject of negotiation, will be discussed only between Central Health and the selected Proposer and will not be deemed an opportunity to amend the Proposer's Proposal. If a Proposer requests significant changes to either the required Contract terms or the terms of the Business Associate Agreement, Proposer's Proposal may be considered non-Responsive and result in Proposers' disqualification or, if such changes are requested post-Proposal submission in violation of this CSP, will result in termination of negotiations and Contract award.

X. Investigate Proposers

The Evaluation Committee may make such investigations as necessary to determine the qualifications and ability of the Proposer to adhere to the requirements specified within this CSP. The Evaluation Committee will reject any Proposal that is submitted by a Proposer who it deems unqualified or who otherwise fails to submit a responsive Proposal.

XI. Request Change in Proposer Representatives

Central Health reserves the right to require a change in the representatives that Proposer submits with the Proposal, if the assigned representatives are not, in the opinion of Central Health, able to adequately meet Central Health's needs.

XII. Assert Ownership of Proposals

All documents submitted in response to this Request for Competitive Sealed Proposals will become the property of Central Health.

XIII. PROPOSAL FORMAT AND ORGANIZATION

This section of the CSP describes the format and organization of the Proposer's Proposal. **Failure to conform to the requirements contained herein may result in disqualification of the Proposal.**

A. Proposal Format

All Proposals, electronic and printed, must delineate each section. The page limit should be **no more than forty (40) pages (20 front/back if printed) not including tabs and requested forms (see item B. below), or as further instructed in this CSP.** If submitting a printed Proposal, the Proposal must be in a binder with tabs delineating each section.

B. Proposal Organization

The Proposal must be organized and indexed in the following format and must contain, as a minimum, all items that are listed as required in the sequence indicated.

1. Letter of Transmittal – Required

- Identify the submitting organization;
- Identify the name, title, e-mail address and telephone number of the person authorized to contractually obligate the organization or individual proposing;
- Identify the name, title, e-mail address, and telephone number of the person authorized to negotiate a Contract on behalf of the organization;
- Identify the names, titles, e-mail addresses, and telephone numbers of persons to be contacted for Proposal clarification;
- Proposed Price including base bid and alternates;
- **Explicitly indicate acceptance of Sections II through IV of this CSP;**
- Be signed by the person authorized to contractually obligate the organization; and
- Acknowledge receipt of all, if any, addenda to this CSP.
 - Table of Contents - Optional
 - Proposal Summary - Optional

- Response to Prompts - **Required**
- Completed and Signed Acknowledgement of Receipt Form - **Required**
- Completed Historically Underutilized Business (HUB) Form - **Required**
- Completed and Signed Conflict of Interest Questionnaire (CIQ) – **Required upon selection**
- Completed and Signed Certificate of Secretary – **Required if Proposer is a corporation**
- Completed Insurance Coverage Form - **Required**
- Other (optional) supporting material (may be included on the electronic device)

The forms listed behind the numbers 5, 6, 8 and 9 must be thoroughly completed, executed and witnessed, if and as required, and included in the appropriate section of the Proposal. Proposals must include all Attachments and Exhibits in order to be considered Responsive.

Any Proposal that does not adhere to these requirements may be deemed non-responsive and rejected on that basis.

XIV. PROPOSAL CONTENT REQUIREMENTS

Proposers shall respond in the form of a detailed narrative to each of the narrative prompts contained in Item A below. The narratives, along with supporting materials, will be evaluated and awarded points accordingly.

Failure to respond to the following mandatory narrative prompts will result in disqualification of the Proposal as non-responsive.

A. Evaluation Criteria

Relevant Experience	10%
Project Management Ability & Key Staff Experience	15%
Current & Past Performance	10%
Subcontractors & Suppliers	5%
Proposal Price	50%
Schedule	10%
Financial Stability	Pass/Fail
Litigation History	Pass/Fail

B. Narrative Prompts

1. Relevant Experience: Based on information provided by Contractor

- Experience- Points awarded based on number of years established as a commercial firm capable of bonding an individual \$9,000,000.00 project.
- Representative Projects- Completed clinic projects.

2. Project Management Ability & Key Staff Experience: Based on information provided and references

- Organizational Structure- based on completed information submitted
 - Provide a complete organizational chart indicating key team members proposed to work full time on the project for the entire length of the project. Organize this

chart to show field personnel and those who will support the project from elsewhere. Identify the location of main office.

- Provide the resumes of the Project Superintendent, Assistant Superintendent(s), and Project Manager. Include information on projects completed together, if any.
- For each key team members, list all of the projects that they have worked on during the past five (5) years, their roles on these projects, and whether or not they were employed by your firm. Provide complete information regarding their project experience including, but not limited to, information requested in 3.1 below.
- Provide a current company safety policy and a safety plan that is specific to the project and proposed construction site.
- Project Superintendent and Project Manager Evaluations- Based on references
 - Questions to Owners- Points awarded for each “yes” response Was the project(s) completed on schedule?
 - Was the project(s) completed within the budget?
- Questions to Architects/Engineers
 - Does the Superintendent/Project Manager have the construction knowledge necessary to successfully carry out his/duties?
 - Is the Superintendent/Project Manager organized in all aspects of their duties?
 - Does the Superintendent/Project Manager stay within standard construction communication practice guidelines?
 - Does the Superintendent/Project Manager complete and process construction related paperwork in a timely manner?
 - Does the Superintendent/Project Manager work to ensure that subcontractors are held accountable for the quality and quantity of their work?
 - Does the Superintendent/Project Manager behave in a professional manner at all times?
 - Is the Superintendent/Project Manager proactive in identifying and dealing with construction related problems and issues?

3. Current and Past Performance- Based on Owner and Architect/Engineer References.

Points awarded based on evaluation team’s knowledge of the contractor’s past experience with the district or other owners. Up to three (3) past healthcare projects will be evaluated based on the following information.

- Contractor to provide a chronological list of all clinic projects completed in the past three (3) years and currently in progress. Include the following information for each project:
 - Project name
 - Project Type
 - Date Project Complete
 - Name of Project Superintendent
 - Name of Project Manager
 - Owner Contact (name, phone & address)
 - Architect/Engineer Contact (name, phone & address)
 - Project Location (city and county)
- Questions to Owner/Architect/Engineer:
 - Were the projects completed on schedule and within budget?

- Were closeout processes organized and completed in a timely fashion?
 - Did the contractor cooperate and work well with the owner's staff?
 - Did the general contractor lead the effort of coordinating subcontractor work?
 - Was the quality of work performed well?
 - Were warranty calls kept to a minimum number?
- 4. Subcontractors and Suppliers- Based on information provided**
- Provide the name of the proposed subcontractor for each of the following trades. Provide each subcontractor's safety policy and the name and resume of the field superintendent.
 - Rubber/Tile/LVT/Carpet Subcontractor
 - Electrical Subcontractor
 - Steel Fabricator & Erector
 - Mechanical Subcontractor
- 5. Proposal Price- Based on proposal form submitted**
- The lowest proposal is based on Base Bid plus accepted Alternates.
 - Fifty (50) points will be awarded for the lowest proposal
 - Points are deducted from proposal greater than the lowest proposal based on 1/3% point variation from the lowest proposal up to 5% difference. Points range from 44 (for 0.33% difference) to 30 (for 5% difference).
 - Proposals with greater than 5% difference will be awarded points based on one (1) point being deducted for each additional 1%. (i.e. 6% difference equals 29 points, 7% difference equals 28 points, etc.)
- 6. Schedule**
- Provide a proposed baseline schedule in Microsoft Projects or comparable Gantt chart format for this work defining a critical path.
 - Schedule Strategies- Provide strategies which are included in the proposal to minimize delays and identify areas for possible time savings.
- 7. Litigation History- Based on information provided by contractor**
Pass/Fail
- Provide a list of all Texas litigation your firm has been involved with for the last five years. If none, provide a signed notarized affidavit stating that the offeror has not been involved in any litigation in Texas from December 1, 2015 to present.
 - List all current and ongoing disputes (those that your firm has had to employ an attorney to act on your behalf) your firm has ongoing with any owner or subcontractor that is related to a construction project. Briefly describe the situation and how you see it being resolved.
- 8. Financial Stability- Based on information provided by contractor**
Pass/Fail
- Provide a current certified audited financial statement
 - Indicate the total number of staff your firm has employed for the past three years.
 - Separate each year's total employees into totals for office and/or field staff categories.

C. Evaluation Process

1. All Proposals will be reviewed for compliance with above and above of this CSP. Proposals deemed non-responsive may be eliminated from further consideration.

2. The Procurement Authority may contact the Proposer for clarification of the Proposal as specified in above.
3. The Evaluation Committee may use other sources of information to perform the evaluation as specified in Proposal Evaluation.
4. Responsive Proposals will be evaluated using the criteria set forth in the table above.

The Proposer whose Proposal is most advantageous to Central Health, taking into consideration the stated EVALUATION CRITERIA, may be recommended for Contract award as specified in above. Proposers who are asked or chosen to submit a revised Proposal for the purpose of obtaining Best and Final Offers may have their points recalculated accordingly. Please note however, that a serious deficiency in the initial Proposal may be grounds for rejection regardless of overall score.

Exhibit C
Acknowledgment of Receipt Form

In acknowledgment of receipt of this Request for Qualifications, the undersigned agrees that he/she has received a complete copy, beginning with the title page and Table of Contents and Exhibits.

The acknowledgment of receipt should be signed, returned, and included with the Respondent's submittal. Complete (Legal) Name of Proposer: _____

Proposer Tax Identification Number: _____

Business Address: _____

Telephone Number: _____

Type of Organization: Individual Partnership Corporation Association

Other (please describe) _____

If incorporated, state of incorporation: _____

Date organization was formed (month/year): _____

The number of years providing services/systems similar to those requested in this Solicitation: _____

Description of Proposer's organization, locations, and number of staff (including subcontractors as applicable) that will provide services/support outlined in this Solicitation):

Please certify the following by placing an "X" in the appropriate column:

Certification	Yes	No
Is Proposer/Respondent currently in the process of filing for bankruptcy?		
Has Proposer/Respondent filed for bankruptcy within the past five (5) years?		
Is the Proposer/Responder delinquent on any taxes owed to Travis County?		
Is the Proposer/Responder currently under suspension or debarment by any governmental entity (City of Austin/state/federal government)?		

Proposer/Responder may be not be considered if currently under suspension or debarment.

Acknowledged Addenda _____ of _____

**Exhibit C
Acknowledgment of Receipt Form**

III. Individual authorized to bind Proposer/Respondent to contract:

Name/Title: _____

Telephone: _____ E-mail: _____

Point of contact information for this Solicitation (if different from authorized individual):

Name/Title: _____

Telephone: _____ E-mail: _____

IV. Terms and Conditions

The required contract terms and conditions identified in the Exhibit G, of this Solicitation, will be incorporated into the contract resulting from this Solicitation, and the Proposer /Respondent's submission will be incorporated into the contract. Please identify whether there are any requested exceptions or deviations.

- I do not request any exceptions or deviations to the stated contract terms.
- I request the following exceptions or deviations to the stated contract terms.

V. Litigation History:

Description of litigation to which the firm has been a party in the most recent five-year period. Please include the following details:

- 1) Name of case
- 2) Date filed
- 3) Court in which filed
- 4) Judgment or result

(Continued on Next page)

Exhibit C
Acknowledgment of Receipt Form

Important: The Proposer/Respondent must respond to all questions. The Proposer/Respondent may attach additional documents to the questionnaire to provide additional details.

Authorized Respondent Signature

Date

Printed Name

Title

**EXHIBIT D
HISTORICALLY UNDERUTILIZED BUSINESS (HUB) FORM**

The Travis County Healthcare District’s policy is to include Historically Underutilized Businesses (HUBs) in its procurement process and to provide equal opportunities for HUB participation in the provision of supplies, services, equipment and construction projects required by the District. As such, the District seeks to ensure that a “good faith effort” is made to assist certified HUB vendors and contractors in its award of contracts and subcontracts.

To be considered as a “Certified HUB Contractor/Vendor”, the contractor/vendor must have been certified by and hold a current and valid certification from any of the following certifying agencies recognized by the District: the Texas Building and Procurement Commission (State of Texas); City of Austin; and the Texas Unified Certification Program (TUCP), which includes six (6) certifying agencies.

Suggested directories to assist proposers in identifying potential HUBs to meet the District’s “good faith effort” requirement include: **State:** <https://comptroller.texas.gov/purchasing/vendor/hub/>;

City: <http://www.austintexas.gov/department/purchasing> ; and

TUCP: <https://www.txdot.gov/business/partnerships/tucp.html>

Proposer HUB Declaration

Is your company certified as a HUB or an MBE/WBE/DBE source? Yes No. If yes,

1. **Attach your certification to this form and return it in the proposal;**

2. Identify the certification agency by checking all that apply;

State of Texas Comptroller HUB Program

City of Austin; Texas Unified Certification Program; and

3. Identify HUB Status (Gender & Ethnicity): _____

****Please complete page 2 - Disclosure of HUB Subcontractors****

Estimated percentage of the bid (proposal) that is to be subcontracted with Certified HUB sources: ___%

**EXHIBIT D
HISTORICALLY UNDERUTILIZED BUSINESS (HUB) FORM**

Disclosure of Subcontractors

Sub Company Name:		EIN/VID #:	
Address:	City:	State:	Zip Code:
Contact:	Phone No.:	Fax No.:	E-mail:
Subcontract Amount:	Percentage:	Description of Work:	
Is the company a certified HUB? <input type="checkbox"/> Yes <input type="checkbox"/> No	Indicate Gender & Ethnicity:		
Certifying Agency (Check all applicable):	State of Texas https://comptroller.texas.gov/purchasing/vendor/hub/ (HUB) <input type="checkbox"/>	City of Austin http://www.austintexas.gov/department/purchasing (M/WBE) <input type="checkbox"/>	Texas Unified Certification Program https://www.txdot.gov/business/partnerships/tucp.html <input type="checkbox"/>
Sub Company Name:		EIN/VID #:	
Address:	City:	State:	Zip Code:
Contact:	Phone No.:	Fax No.:	E-mail:
Subcontract Amount:	Percentage:	Description of Work:	
Is the company a certified HUB? <input type="checkbox"/> Yes <input type="checkbox"/> No	Indicate Gender & Ethnicity:		
Certifying Agency (Check all applicable):	State of Texas https://comptroller.texas.gov/purchasing/vendor/hub/ <input type="checkbox"/> (HUB) <input type="checkbox"/>	City of Austin www.ci.austin.tx.us/purchase/default.htm (M/WBE) <input type="checkbox"/>	Texas Unified Certification Program https://www.txdot.gov/business/partnerships/tucp.html (DBE) <input type="checkbox"/>
Sub Company Name:		EIN/VID #:	
Address:	City:	State:	Zip Code:
Contact:	Phone No.:	Fax No.:	E-mail:
Subcontract Amount:	Percentage:	Description of Work:	
Is the company a certified HUB? <input type="checkbox"/> Yes <input type="checkbox"/> No	Indicate Gender & Ethnicity:		
Certifying Agency (Check all applicable):	State of Texas https://comptroller.texas.gov/purchasing/vendor/hub/ (HUB) <input type="checkbox"/>	City of Austin www.ci.austin.tx.us/purchase/default.htm (M/WBE) <input type="checkbox"/>	Texas Unified Certification Program https://www.txdot.gov/business/partnerships/tucp.html (DBE) <input type="checkbox"/>

EXHIBIT E
Conflict of Interest Questionnaire

CONFLICT OF INTEREST QUESTIONNAIRE
For vendor doing business with local governmental entity

FORM CIQ

This questionnaire reflects changes made to the law by H.B. 23, 84th Leg., Regular Session.

This questionnaire is being filed in accordance with Chapter 176, Local Government Code, by a vendor who has a business relationship as defined by Section 176.001(1-a) with a local governmental entity and the vendor meets requirements under Section 176.006(a).

By law this questionnaire must be filed with the records administrator of the local governmental entity not later than the 7th business day after the date the vendor becomes aware of facts that require the statement to be filed. See Section 176.006(a-1), Local Government Code.

A vendor commits an offense if the vendor knowingly violates Section 176.006, Local Government Code. An offense under this section is a misdemeanor.

OFFICE USE ONLY

Date Received

1 Name of vendor who has a business relationship with local governmental entity.

2 Check this box if you are filing an update to a previously filed questionnaire. (The law requires that you file an updated completed questionnaire with the appropriate filing authority not later than the 7th business day after the date on which you became aware that the originally filed questionnaire was incomplete or inaccurate.)

3 Name of local government officer about whom the information is being disclosed.

Name of Officer

4 Describe each employment or other business relationship with the local government officer, or a family member of the officer, as described by Section 176.003(a)(2)(A). Also describe any family relationship with the local government officer. Complete subparts A and B for each employment or business relationship described. Attach additional pages to this Form CIQ as necessary.

A. Is the local government officer or a family member of the officer receiving or likely to receive taxable income, other than investment income, from the vendor?

Yes No

B. Is the vendor receiving or likely to receive taxable income, other than investment income, from or at the direction of the local government officer or a family member of the officer AND the taxable income is not received from the local governmental entity?

Yes No

5 Describe each employment or business relationship that the vendor named in Section 1 maintains with a corporation or other business entity with respect to which the local government officer serves as an officer or director, or holds an ownership interest of one percent or more.

6 Check this box if the vendor has given the local government officer or a family member of the officer one or more gifts as described in Section 176.003(a)(2)(B), excluding gifts described in Section 176.003(a-1).

7

Signature of vendor doing business with the governmental entity

Date

EXHIBIT F
CERTIFICATE OF SECRETARY
(Required for bidders which are corporations)

I CERTIFY that:

I am the duly qualified and acting Secretary of _____,
[Name of Corporation]

a duly organized and existing corporation of the State of _____.
[Name of State]

The following is a true copy of a Resolution duly adopted by the Board of Managers of such corporation in a meeting legally held on the _____ day of _____, 20____, and entered in the minutes of such meeting in the minute book of the Corporation.

RESOLVED, that this corporation enter and that _____, the
[Insert Name of Person Executing Bid Form]
_____ of this corporation, is authorized and directed to execute on behalf of and
[Position with Corporation]

as the act of this corporation the Bid Form for the Travis County Healthcare District dba Central Health
Description: _____, Project # _____, together
with all associated documents and, should this corporation be the successful bidder for that project, to execute on
behalf of and as the act of the corporation all necessary documents to effect a written contract between this
corporation and Travis County Healthcare District dba Central Health for the Construction of the Travis County
Healthcare District dba Central Health.

[Insert Name and Number of Project]

The Secretary is directed to attach a copy of the Bidding Documents to the minutes of this meeting and to make them a part of the corporate records.

The above Resolution is in conformity with the Articles of Incorporation and the Bylaws of the Corporation has never been modified or repealed and is now in full force and effect.

Date _____

Secretary _____

President _____

EXHIBIT G
CONSTRUCTION AGREEMENT

This Construction Contract is made as of _____, 20____ (the “Effective Date”), by and between

The Owner: Travis County Healthcare District d/b/a Central Health
1111 East Cesar Chavez Street
Austin, Texas 78702
512 / 978-8000

And Contractor:

For the Project known as: General Contractor for Del Valle Health & Wellness Center

Contract Sum: \$

Project Architect/Engineer: O’Connell Robertson

The Contractor is the person or entity identified as such in the Construction Contract and will be referred to as if singular in number and masculine in gender. The term Contractor means the Contractor or his authorized representative.

The Contractor agrees that:

The Contractor will, coordinate and cooperate with the Owner and the Owner’s Architect/Engineer and other consultants, and proactively work to eliminate conflicts within the Work. He will provide without limit, all labor, materials, equipment, and similar resources to ensure the most expedient and safe performance of the Work. He will attentively manage the construction and protect the Owner against cost increases, Project delay, and deficient work.

The Owner and Contractor agree as follows:

TABLE OF CONTENTS

ARTICLE

- 1 SCOPE OF WORK
- 2 CONTRACT DOCUMENTS
- 3 COMMENCEMENT AND SUBSTANTIAL
COMPLETION DATES
- 4 CONTRACT SUM & COST DETAIL
- 5 BONDS AND INSURANCE
- 6 CONTRACT PAYMENTS
- 7 GENERAL PROVISIONS
- 8 OWNER'S RESPONSIBILITIES
- 9 ARCHITECT/ENGINEER'S
RESPONSIBILITIES
- 10 CONTRACTOR'S RESPONSIBILITIES
- 11 DISPUTE RESOLUTION
- 12 CONTRACT SUSPENSION AND
TERMINATION
- 13 INDEMNITY
- 14 SPECIAL WARRANTIES
- 15 NOT USED
- 16 MISCELLANEOUS PROVISIONS

CONTRACT ATTACHMENTS

- A Not Used
- B Contractor' Schedule (To Be Added)
- C Contractor's Schedule of Values (to be added)
- D Insurance
- E Liquidated Damages Schedule
- F (Not Used)
- G (Not Used)
- H Performance and Payment Bond
- I Certificate of Interested Parties

ARTICLE 1 - SCOPE OF WORK

- 1.1 The Contractor has overall responsibility for and will furnish all materials, equipment, tools, labor and similar items as necessary or reasonably inferable to complete the Work, or any phase of the Work, in accordance with the Owner's requirements and the terms of the Contract Documents.
- 1.2 The Contractor will fully execute the Work described in the Contract Documents, except work specifically indicated in the Contract Documents to be others' responsibility.
- 1.3 The Construction Contract will not be construed to create any contractual relationship of any kind between the Owner and any Subcontractor or Sub-subcontractor, as those terms are defined herein.
- 1.4 Construction will commence upon the date specified in a written Notice to Proceed, which will be issued by Owner after approval of the Contract Sum, and will continue until Final Completion of all Work. Construction may provide for Work phasing to provide cost or time advantage to the Owner and Project. Unless otherwise agreed, Contractor will not incur any Subcontractor costs for construction of the Work prior to Owner's issuing the Notice to Proceed.

ARTICLE 2 - CONTRACT DOCUMENTS

- 2.1 The Contract Documents consist of:
 - 2.1.1 This Agreement and all exhibits and attachments listed, contained or referenced in this Agreement, Owner's supplemental scope of work requirements, definitions or clarifications, and Contractor's Proposal;
 - 2.1.2 The Drawings, Specifications, scope definition, and clarifications, details and other Construction Documents that have been accepted by Owner and developed by Architect/Engineer or Owner's other consultants to describe the Project;
 - 2.1.3 All Construction Documents' Addenda issued prior to the Effective Date of this Agreement;
 - 2.1.4 All Change Orders issued after the Effective Date of this Agreement;
 - 2.1.5 The CSP 2108 General Contractor for Del Valle Health Wellness Center and all its attachments and exhibits;
 - 2.1.6 Contractor's material quality and conformance certifications executed during the Work construction;
 - 2.1.7 Construction Schedule and other documents identified per Contract; and
 - 2.1.8 Other documents and/or attachments included or made part of this Agreement.
- 2.2 The Contract Documents form the entire and integrated Contract between Owner and Contractor and supersede all prior proposals, negotiations, representations or agreements, written or oral.
- 2.3 The term "Contractor" will be interchangeable with the terms "General Contractor" or other similar terms as appropriate in the Contract Documents.
- 2.4 Documents Use and Ownership.
 - 2.4.1 Drawings, specifications, and other documents prepared by the Architect/Engineer, its consultants, or other consultants retained by the Owner for the Project that describe the Work to be executed by the Contractor (the "Construction Documents") are instruments of service and will remain the property of the Owner whether the Project for which they are made is executed or not. The Contractor will be permitted to retain one record set of the Construction Documents. All other copies of the Construction Documents will be returned to the Owner as required, or will otherwise be suitably accounted for or destroyed. The Contractor and its Subcontractors are authorized to reproduce and use portions of the Construction Documents as necessary and appropriate for the execution of the Work. The Contractor and its Subcontractors will not use the Construction Documents on any other projects.

- 2.4.2 Submission or distribution of the Construction Documents to meet official regulatory requirements or for other purposes in connection with the Project will not diminish the Owner's rights.

ARTICLE 3 – COMMENCEMENT AND SUBSTANTIAL COMPLETION DATES

- 3.1 TIME LIMITS STATED IN THE CONTRACT DOCUMENTS ARE OF THE ESSENCE.
- 3.2 Unless otherwise approved, the Contractor will perform its obligations under the Contract Documents as expeditiously as is consistent with reasonable skill and care and the orderly progress of the Work.
- 3.3 The Commencement Date of the Work will be established per Owner's Notice to Proceed issued to Contractor. The Contractor will achieve Substantial Completion no later than _____, subject to adjustments and extension of time, if any, approved by the Owner or change order.
- 3.4 Contract Time will be measured from the Commencement Date. The Project Work will be performed as directed by the Contractor to complete the Work within the specified Contract Time unless otherwise provided by Contract Documents.
- 3.5 Substantial Completion.
- 3.5.1 The date of "Substantial Completion" of the Work or designated portion thereof is the date accepted by the Owner as the date when construction is sufficiently complete, in accordance with the Contract Documents, so the Owner can occupy the building or utilize the Work or designated portion thereof for the use for which it is intended. A Certificate of Occupancy or Temporary Certificate of Occupancy, issued by the governing authority, is required for Substantial Completion unless waived by the Owner.
- 3.5.2 The Contractor will achieve Substantial Completion of the entire Work not later than the date stated in Section 3.3, subject to the timely receipt of a general building permit and subject to adjustments of the Contract Time as provided in the Contract Documents.
- 3.5.3 Substantial Completion will require without limitation, that: i) all systems and parts required for occupancy are functional; ii) all utilities necessary for occupancy are connected and operating in accordance with Contract Documents; iii) all permits required for occupancy have been issued including, but not limited to a Temporary or final Certificate of Occupancy or jurisdictional equivalent as applicable; iv) normal vehicular and pedestrian traffic routes to the Project are not obstructed by Contractor's operations; and v) Architect has performed its inspection of the Work or designated portion thereof and determines the Work to be complete, which determination will not be unreasonably withheld. Upon the occurrence of the above, the Project or designated portion thereof will be deemed Substantially Complete and, the Architect will issue a Certificate of Substantial Completion for the designated portion or whole of the Work. Warranties called for by the Contract Documents will commence on Final Completion of all the Work. Within two (2) weeks of Substantial Completion, a "punch list" will be established by the Owner, Architect, and Contractor that lists all items of the Work or designated portion thereof to be completed or corrected. Contractor will complete all items listed on the "punch list" within thirty (30) days of the date of Substantial Completion provided such items are reasonably capable of being completed within this time frame.
- 3.5.4 Liquidated Damages. Should the Contractor fail to meet the date for Substantial Completion as set forth in Attachment B, subject only to adjustments of the Contract Time as provided in the Contract Documents, the parties agree that the Owner will suffer financial damages which are at present difficult or impossible to estimate, and that it is the intent of the parties to provide for compensatory damages and a degree of certainty in this contract, therefore the Contractor will, as Liquidated Damages and not as a penalty, be liable to Owner for the Liquidated Damages established in Attachment E. Owner will be able to deduct the amounts due under this Section from any payment that may become due to the Contractor. Should the Liquidated Damages amount due from Contractor to Owner exceed the

amount otherwise due or payable to Contractor by Owner, Contractor will promptly pay to Owner, the balance of Liquidated Damages. In the event that Contractor fails to achieve Substantial Completion of the Work, then, if Owner has previously accepted designated portion(s) of the Work, any Liquidated Damages payable by Contractor to Owner will be reduced by the following ratio: value of accepted Work relative to the total Contract Sum. Contractor agrees that, in addition to liquidated damages, Owner may exercise against Contractor any other right or remedy available under this Contract.

ARTICLE 4 – CONTRACT SUM & COST DETAIL

- 4.1 The Contract Sum is defined and described in the Agreement and, including authorized adjustments thereto, is the total amount payable by the Owner to the Contractor for performance of the Work. The Contract Sum is as defined in Attachment C – Contract Sum and Cost Conditions.
- 4.2 Allowances, and alternates, if any, are listed in Attachment C.
- 4.3 The Contract Sum is based upon laws, codes, and regulations enacted and effective as of the date of this Agreement.
- 4.4 The Contract Sum allows for and includes all services, items, and work required for the complete and correct performance of the Work in conformance with the requirements of the Contract Documents.
- 4.5 Change Orders
- 4.5.1 A “Change Order” is a written modification to the Contract signed by the Owner, the Architect/Engineer, and the Contractor issued after award of the Construction Contract authorizing a change in the Work and an adjustment, if any, in the Contract Sum or the Contract Time. The Contract Sum and the Contract Time may be changed only by Change Order. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract Sum or the Contract Time.
- 4.5.2 Routine changes in the Construction Contract shall be formally initiated by the Architect/Engineer by means of a “Change Proposal Request (“CPR”)” form detailing requirements of the proposed change. The Contractor shall prepare a Change Proposal (“CP”) based on the CPR form. This action may be preceded by communications between the Contractor, Architect/Engineer, and Owner concerning the need for and nature of the change, but such communications shall not constitute a basis for beginning the proposed Work by the Contractor. Except for emergency conditions defined in subparagraph 4.5.10 or for conditions described in subparagraph 4.6.3, the Owner must approve the Contractor’s Change Proposal by the Architect/Engineer and Owner and authorize the Contractor to proceed with the Change Order Work. Without prior approval the Contractor may be required to remove Work so installed.
- 4.5.3 The cost or credit to the Owner resulting from Change Order Work shall be determined in one or more of the following ways:
- 4.5.3.1 by mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- 4.5.3.2 by unit prices stated in the Construction Documents, if any, or subsequently agreed upon; or
- 4.5.3.3 by a cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee. (The Contractor shall keep and present, in such form as the Architect/Engineer or the Owner may prescribe, an itemized accounting together with appropriate supporting data for inclusion in a Change Order.)
- 4.5.4 All proposed costs for Change Order Work must be supported by an itemized accounting of material, equipment, and associated itemized installation costs in sufficient detail to permit analysis by the Architect/Engineer and Owner using current estimating guides and/or prices. Photocopies of Subcontractor and significant vendor proposals supporting the Contractor’s Change Proposal shall be furnished unless specifically waived by the Owner. The Contractor shall provide written response to a Change Proposal Request within ten (10) working days of receipt, unless otherwise specified in the

Supplementary Conditions, if applicable.

- 4.5.5 Unless otherwise provided in the Contract Documents, the “Change Order Base Cost” shall be limited to the following:
 - 4.5.5.1 The total cost of materials and supplies, reflecting all available discounts, itemized by cost and quantity;
 - 4.5.5.2 The total cost of all labor, including the cost of additional supervision, itemized to show man-hours by trade and classification and burdened hourly rates (which include social security tax, unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance)
 - 4.5.5.3 The rental value of equipment and machinery calculated for each type of equipment used in performing the changed Work, based on hours of use. Unless otherwise specified, prices for use of machinery and equipment shall be determined by using 80 percent of the latest schedule of “Equipment Ownership Expense” adopted by Associated General Contractors of America. Mobilization costs will not be allowed except when the Contractor demonstrates that the need to mobilize a piece of equipment arose solely because of the changed Work;
 - 4.5.5.4 All transportation costs for delivery and handling of materials, equipment, and supplies, and the removal of waste or debris;
 - 4.5.5.5 All storage costs in excess of thirty (30) days for materials and supplies, if necessitated solely by the changed Work;
 - 4.5.5.6 Sales taxes are not to be included in charges for materials that are tangible personal property incorporated into the Project or completely consumed at the job site and services required by or integral to the performance of the Construction Contract, as provided in Texas Tax Code Section 151.311.
- 4.5.6 The amounts that the Contractor or a Subcontractor adds to the Change Order Base Cost for overhead and profit will also be considered by the Owner before approval is given. The amounts established hereinafter are the maximums that are acceptable to the Owner without a full and complete justification acceptable to the Owner.
 - 4.5.6.1 To the total of the Change Order Base Cost, the Contractor will be allowed to add a percentage as noted below to cover overhead and profit combined. Overhead shall be considered to include insurance other than mentioned above, office supervisors and assistants, use of small tools, incidental job burdens and general home office expense, and no separate allowance will be made therefor. Allowable percentages for overhead and profit on changes will not exceed 15% on the first \$10,000.00, 10% on the next \$10,000.00 and 7 1/2% on the balance over \$20,000.00.
 - 4.5.6.2 The allowance to the Contractor for profit and overhead for work done by his own forces or by Subcontractors will be a minimum of \$50.00.
 - 4.5.6.3 On changes involving both additions and deletions, percentages for overhead and profit will be allowed only on the net addition.
 - 4.5.6.4 The amount of credit to be allowed by the Contractor to the Owner for any deletion or change which results in a net decrease in the Contract Sum will be the amount of the actual net cost.
- 4.5.7 No payments can be made on such work until the final amount is agreed and the Change Order approved.
- 4.5.8 The execution of a Change Order by the Owner and the Contractor constitutes the full, final and complete settlement of all claims with regard to the modifications contained in the Change Order for foreseeable impacts on the Contract Sum or the Contract Time.
- 4.5.9 Emergency changes to save life or property may be initiated by the Contractor alone with the claimed cost of such Work to be fully documented as to necessity and detail of the reported costs in accordance with subparagraph 4.6.5.

4.5.10 The cumulative total of all Change Orders may not increase the Contract Sum by more than twenty-five percent (25%). The Contract Sum may be decreased by more than eighteen percent (18%) only with the consent of the Contractor.

4.6 Construction Change Directive

4.6.1 A Construction Change Directive, (a “CCD”), is a written order prepared by the Architect/Engineer and signed by the Owner and Architect/Engineer, directing a change in the Work and stating a proposed basis for adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Construction Contract, order changes in the Work within the general scope of the Construction Documents consisting of additions, deletions or other revisions, the Contract Sum, and the Contract Time being adjusted accordingly. All such changes in the Work shall be performed under the applicable conditions of the Contract Documents.

4.6.2 A Construction Change Directive shall be used if one of the following circumstances applies:

4.6.2.1 If the Contractor fails to provide a written Change Proposal within 10 days of receiving a Change Proposal Request or fails or refuses to execute an agreed Change Order within the time required to prevent a delay to the Construction Schedule;

4.6.2.2 If negotiations fail to achieve an agreed price; or

4.6.2.3 If, in the Owner’s judgement based on the Construction Schedule, a failure to authorize the Contractor to proceed with a Change Order under the normal process may adversely affect the timely completion of the Work.

4.6.3 Any unexpected circumstances which necessitates an immediate change in order to prevent damage to the Work in place, to avoid a delay in the Construction Schedule, or to maintain safety shall be expedited by verbal communication and authorization between the Contractor, Architect/Engineer and Owner with written Construction Change Directive following as soon as may be practical. Should consultation with all other interested parties be precluded by events, the Owner may act alone. A limiting not-to-exceed estimate of cost will be requested prior to authorizing Work to proceed. Should a cost estimate be impractical for any reason, the Owner may authorize the use of detailed cost records of such Work to establish and confirm the actual costs for documentation in a formal Change Order.

4.6.4 If the Construction Change Directive provides for an adjustment to the Contract Sum, the basis and method for determining the cost or credit to the Owner shall be in accordance with either 4.5.3 or as described below.

4.6.5. If the Contractor does not respond promptly or disagrees with the method for adjustment of the Contract Sum, the Contractor shall be paid “Actual Field Cost” plus overhead and profit. “Actual Field Cost” is calculated to include the same costs as outlined in 4.5.5, also known as the Change Order Base Cost. Overhead and profit is determined in accordance with subparagraph 4.5.6. The Owner may direct the form in which accounts of Actual Field Cost shall be kept and records of those accounts shall be made available to the Owner. When Contractor’s field office must be maintained solely on account of such extra work; then the cost to maintain and operate the same shall be included in Actual Field Cost.

4.6.6 When Actual Field Cost is used to determine the cost of the Construction Change Directive, the Contractor shall provide the Owner records of Work done for the CCD at the end of each day. Copies of these records will be made upon suitable forms approved for this purpose by the Owner and signed by Contractor. All claims for work performed for the CCD shall be submitted to the Architect/Engineer by the Contractor upon certified statements to which shall be attached certified copies of invoices covering the cost of, and the freight charges on, all materials used in such Work. Such statements shall be filed not later than the tenth day of the month following that in which the work was actually performed. The statements shall separate charges in accordance with subparagraph 4.5.5.

4.6.7 When the estimated cost of work related to the CCD is less than \$500.00, payment of same may be

made on the basis of an invoice submitted to the Architect/Engineer by the Contractor. The invoice shall include the Contractor's actual cost for materials, labor, equipment and incidentals necessary to complete the extra work.

- 4.6.8 When the Owner and Contractor agree on the adjustments to the Contract Sum and Contract Time, such agreement shall be recorded by preparation and execution of an appropriate Change Order in accordance with 4.5.1.

ARTICLE 5 – PERFORMANCE & PAYMENT BONDS AND INSURANCE

- 5.1 Upon acceptance by Owner of Contractor's Contract Sum, Contractor will provide performance and payment bonds on forms prescribed by Owner and in accordance with Contract Documents. The penal sum of the payment and performance bonds will be equal to the Contract Sum.
- 5.2 The Contractor must obtain and maintain insurance policies and provide certificates evidencing such coverage in strict compliance with terms, conditions, and provisions set forth on Attachment D.

ARTICLE 6 – CONTRACT PAYMENTS

6.1 Contract Sum

- 6.1.1 The Contract Sum is defined and described in the Agreement for Construction Services and, including authorized adjustments thereto, is the total amount payable by Owner to the Contractor for the performance of the Work under the Construction Documents.

6.2 Schedule of Values

Before the first Application for Payment, as defined herein, the Contractor shall submit to the Architect/Engineer a schedule of values allocated to the various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Owner or the Architect/Engineer may require. This schedule, unless objected to by the Owner or the Architect/Engineer, shall be used only as a basis for the Contractor's Applications for Payment.

6.3 Applications for Payment.

- 6.3.1 Contractor will submit monthly Applications for Payment by the tenth (10th) day of the month for Work completed in the prior month. The period covered for each Application for Payment will be from the 1st to the last day of the month, inclusive. Contractor's Applications for Payment will be submitted in triplicate on properly completed AIA Forms G702 and G703 or an equivalent form acceptable to Owner and in executable electronic format (MS Excel). The Application will be based on the approved schedule of values for each Bid or Trade Package, the Contractor's Fee, General Conditions, Contractor's Contingency, Allowances, and any Change Orders. All columns on the AIA G702 and G703 Forms will be properly completed and reflect all corrections, if any, from the previous month's Application for Payment. Supporting documentation, to include Subcontractor invoices, purchase orders, approved change orders, timecards with weather day reporting, lien waivers, Contractor's construction schedule, and photos of completed work, will be submitted with each Application for Payment. In each Application for Payment, Contractor will clearly identify and list all adjustments to the approved schedule of values to include without limit, changes in and between Allowances.

- 6.3.2 Payments may be made on account of materials or equipment not incorporated in the Work but delivered and suitably stored at the site. If approved in advance by the Owner, payments may similarly be made for materials or equipment suitably stored at some other location agreed upon in writing. Payments for materials or equipment stored on or off the site shall be conditioned upon submission by the Contractor of bills of sale or such other procedures satisfactory to the Owner to establish the Owner's title to such materials or equipment or otherwise protect the Owner's interest, including applicable insurance and transportation to the site for those materials and equipment stored off the site.

- 6.3.3 The Contractor warrants that title to all Work, materials, and equipment covered by an Application for Payment will pass to the Owner either by incorporation in the construction or upon the receipt of payment by the Contractor, whichever occurs first, free and clear of all liens, claims, security interests, or encumbrances, hereinafter referred to in this Article 9 as "liens"; and that no Work, materials, or equipment covered by an Application for Payment will have been acquired in the Contractor's behalf, or by any other person performing Work at the site or furnishing materials and equipment for the Project. Rather, the purchase shall be in the Owner's behalf.
- 6.3.4 First payment will be made without Lien Waivers. Lien Waivers must accompany all subsequent Applications for Payment from the Contractor, its Subcontractors and their subcontractors, and suppliers for the principal portions of the Work covering one hundred percent (100%) of the amounts paid for the previous calendar months. All Lien Waivers must show the amounts paid and be in a format and include content acceptable to Owner. All Lien Waivers must be originals and signed in order to be valid. Owner may withhold payment of amounts associated with incomplete or incorrect Lien Waivers.
- 6.3.5 Each Schedule of Values submitted with an Application for Payment will include the originally established value for each work classification line item or subcontract and will identify any Owner approved revisions to the costs for each work classification or subcontract. Work classifications/divisions will follow and be based on CSI work divisions. Schedule of Values will not be adjusted without Owner approval, such approval not unreasonably withheld. The format and tracking method of the original schedule of values and of all updates will be subject to approval by the Owner. At all times, the estimated cost of performing the uncompleted and unpaid portion of the Work, including Contractor's Fee, will not exceed the unpaid balance of the Contract Sum less retainage on Work previously completed.
- 6.3.6 No partial payment made by the Owner will constitute, or be construed to constitute, final acceptance or approval of the work to which the partial payment relates or of the documentation provided in support of the partial payment. No partial payment made by the Owner will constitute, or be construed to constitute, a release of Contractor from any of its obligations or liabilities with respect to the Work.
- 6.3.7 Owner will have the right to verify and audit the details of Contractor's billings, certificates, accountings, cost data, and statements, either before or after payment, by (1) inspecting the books and records of Contractor during normal business hours; (2) examining any reports with respect to this Project; (3) interviewing Contractor's employees; (4) visiting the Project site; and (5) any other reasonable action. Contractor's records will be kept on the basis of generally accepted accounting principles (GAAP) in accordance with cost accounting standards issued by the Financial Accounting Standards Board and organized by each Application for Payment period.

6.4 Certificates for Payment

- 6.4.1 The Owner will, within twenty-one (21) days after the receipt of the Contractor's Application for Payment, either approve and process Application for Payment, with a copy to the Contractor, for such amount as the Owner determines is properly due or notify the Contractor in writing his reasons for not approving the Application for Payment as provided in subparagraph 6.6.1.
- 6.4.2 The issuance of an Application for Payment will constitute a representation by the Owner, based on his observations at the site and the data comprising the Application for Payment, that the Work has progressed to the point indicated, that the quality of the Work is in accordance with the Construction Documents, and that the Contractor is entitled to payment in the amount certified. This certification is subject to an evaluation of the Work for conformance with the Construction Documents upon Substantial Completion, to the results of any subsequent tests required by or performed under the Construction Documents, to minor deviations from the Construction Documents correctable prior to completion of the Work, and to any specific qualifications stated in the Application for Payment. However, by issuing an Application for Payment, the Owner shall not thereby be deemed to represent

that he had made continuous on-site inspections to check the quality or quantity of the Work or that he has made any examination to ascertain how or for what purpose the Contractor has used the monies previously paid on account of the Contract Sum.

6.5 Progress Payments

- 6.5.1 After Owner has received the Application for Payment, the Owner shall make payment within thirty (30) days, however if the Owner notified the Contractor in writing of any objections to payment within twenty-one (21) days, only the undisputed portion will be paid. Objections to payment shall be for any incurred breach of the Contract Documents by the Contractor, including, but not limited to, the specific grounds for withholding payment set forth in subparagraph 6.6.1. The Owner shall retain not less than five percent (5%) of each payment until final completion and acceptance of all Work covered by the Construction Contract.
- 6.5.2 The Contractor shall promptly pay each Subcontractor upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's Work, the amount of which said Subcontractor is entitled, reflecting the percentage actually retained, from payments to the Contractor on account of such Subcontractor's work. The Contractor shall, by an appropriate agreement with each Subcontractor, require each Subcontractor to make payments to his Sub-subcontractors in similar manner. All payments to Subcontractors and Sub-subcontractors shall be made within ten (10) days of receipt of payment for Work claimed in an Application for Payment that Subcontractor or Sub-subcontractor performed. Such Application for Payments shall designate the dollar amount of Work which Subcontractor or Sub-subcontractor provided to allow for the Owner's tracking of Historically Underutilized Business ("HUB") Program requirements.
- 6.5.3 The Owner may, on request and at his discretion, furnish to any Subcontractor, if practicable, information regarding the percentage of completion or the amounts applied for by the Contractor and the action taken thereon by the Architect/Engineer and the Owner on account of work done by such Subcontractor.
- 6.5.4 Neither the Owner nor the Architect/Engineer shall have any obligations to pay or to see to the payment of any monies to any Subcontractor except as may otherwise be required by law.
- 6.5.5 No approval of Application for Payment, nor any Progress Payment, nor any partial or entire use or occupancy of the Project by the Owner, shall constitute an acceptance of any Work not in accordance with the Contract Documents.
- 6.5.6 Payments will be made by check or electronic transfer of funds by Owner upon satisfactory delivery and acceptance of the goods or services required under this Contract. Electronic applications for payment and invoices in accordance with the Contract Documents, shall be sent to: Finance@centralhealth.net with copy to Central Health's Project Manager
- 6.5.7 Taxpayer ID Number Required. Before Owner can process an Application for Payment, the Contractor must provide Owner with an Internal Revenue Form W-9, Request for Taxpayer Identification Number and Certification that is completed in compliance with the Internal Revenue Code, its rule and regulations.

6.6 Payments Withheld

- 6.6.1 The Owner may decline to approve the Application for Payment in whole or in part, to the extent reasonably necessary, if in his opinion he is unable to confirm, based on his observations at the site and the data compromising the Application for Payment, that the Work has progressed to the point indicated, that the quality of the Work is in accordance with the Contract Documents and the Contractor is entitled to payment in the amount approved. In such situations, Owner will notify the

Contractor as provided in subparagraph 6.4.1. If the Contractor and the Owner cannot agree on a revised amount, the Owner will promptly revise and approve the Application for Payment for the amount for which he is able to confirm. The Owner may also decline to approve payment or, because of subsequently discovered evidence or subsequent observations, he may nullify the whole or any part of any Application for Payment previously issued, to such extent as may be necessary in his opinion to protect the Owner from loss because of:

- 6.6.1.1 defective Work not remedied;
 - 6.6.1.2 third party claims filed or reasonable evidence indicating probable filing of such claims;
 - 6.6.1.3 failure of the Contractor to make payments properly to Subcontractors or for labor, materials, or equipment;
 - 6.6.1.4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
 - 6.6.1.5 damage to the Owner or another contractor;
 - 6.6.1.6 reasonable evidence that the Work will not be completed within the Contract Time;
 - 6.6.1.7 failure to carry out the Work in accordance with the Construction Documents; or
 - 6.6.1.8 Contractor's failure to correct any serious violation of OSHA standards or non-compliance with Construction Documents related to Protection of Persons and Property.
- 6.6.2 When the above grounds in subparagraph 6.6.1 are removed, payment shall be made for amounts withheld because of them.
- 6.6.3 Owner will have the right to withhold from payments due Contractor such sums as are necessary to protect Owner against any loss or damage which may result from negligence by Contractor or any Subcontractor or failure of Contractor or any Subcontractor to perform their obligations under this Agreement.
- 6.6.4 Notwithstanding any other contractual provision to the contrary, Owner may reduce the Contractor's payment application amount as necessary to protect the Owner's interest under any of the following circumstances:
- 6.6.4.1 Contractor persistently fails to perform the Work in accordance with the Contract Documents, including the Schedule Requirements attached thereto, or is otherwise in material breach or default under this Agreement;
 - 6.6.4.2 The payment request has insufficient documentation to support the amount of payment requested for Project costs; provided, however, Owner will pay for allowable Project costs for which there is sufficient documentation;
 - 6.6.4.3 Contractor is in violation of the Prevailing Wage requirements or has failed to make payments promptly to Subcontractors or other third parties used in connection with any services or materials for which Owner has made payment to Contractor;
 - 6.6.4.4 Contractor is insolvent, makes a general assignment for the benefit of its creditors or otherwise seeks protection under the laws and regulations of the bankruptcy courts; or
 - 6.6.4.5 Contractor fails to obtain, maintain or renew insurance coverage as required by the Agreement.

6.7 Failure of Payment

- 6.7.1 If the Owner does not approve an Application for Payment, through no fault of the Contractor, within twenty-one (21) days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within thirty (30) days of receipt of the Application for Payment,

then the Contractor may, upon ten (10) additional days' written notice to the Owner, commencing upon Owner's receipt of such notice, stop the Work until payment of the amount owing has been received. The Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shut-down, delay, and start-up, which shall all be affected by appropriate Change Order.

6.8 Final Payment

- 6.8.1 The Contractor's Request for Final Payment will not be made until all Work is completed and all requirements of the Construction Documents are satisfied including, without limitation: delivery to Owner of a complete release of all liens and claims arising out of the Work; written consent of surety to release of final payment; delivery of complete As-Built drawings, delivery of all manufacturer and product warranties; delivery to the Owner of a written and executed waiver of claims against the Owner as described in Section 6.8.4 below; and an affidavit that, to the best of the Contractor's information, knowledge and belief, all known debts and claims arising from the Project have been satisfied.
- 6.8.2 Owner will have no obligation to make Final Payment until the Punch List has been completed in its entirety.
- 6.8.3 Nothing contained herein will require Owner to pay the Contractor an aggregate amount for the Work that exceeds the Contract Sum or to make any payment if, the Owner believes, the cost to complete the Work would exceed the Contract Sum less previous payments to Contractor.
- 6.8.4 Acceptance by the Contractor or the Contractor's successors of Final Payment will constitute a full and complete release of Owner from any and all claims, demands, and causes of action whatsoever that Contractor, its Subcontractors, suppliers and consultants or any of their successors or assigns have or may have against Owner arising from the Project or any provision(s) of this Agreement except for those previously made in writing and identified by Contractor as unsettled at the time of the Request for Final Payment.

ARTICLE 7 – GENERAL PROVISIONS

- 7.1 Definitions. The terms, words and phrases used in the Contract Documents will have the meanings given in the General Conditions and as follows:
 - 7.1.1 **Architect/Engineer** means the professional architect and/or engineer employed by the Owner as architect or engineer of record for the Project and its consultants.
 - 7.1.2 **Construction Documents** means, collectively, the Drawings, Specifications, details, Change Orders and other documents prepared by the Architect/Engineer, its consultants and by the Owner's other consultants that describe the scope and quality of the Project and the materials, supplies, equipment, systems and other elements that are required for construction of the Project that are accepted by the Owner, and the General and Supplemental Conditions of the Contract, if any.
 - 7.1.3 **Contract Sum** means the total amount of all compensation payable to the Contractor for the Project subject to adjustment for Additional Services or Change Orders. Any costs that exceed the Contract Sum will be borne solely by Contractor without reimbursement by Owner.
 - 7.1.4 **General Conditions Cost** means costs incurred by the Contractor without the need for competitive bids/proposals. The allowable General Conditions Cost items are further described and limited as part of Attachment C.
 - 7.1.5 **Owner** means the Owner of the Project and will be referred to as if singular in number and masculine in gender. The term Owner means Central Health, or its designated and authorized representative (Project Manager).

- 7.1.6 **Project** means the entire construction job, of which the Work performed under the Contract Documents may be the whole or a part.
- 7.1.7 **Project Team** means the Owner, Contractor, Architect/Engineer and its consultants, any separate contractors employed by Owner, and other consultants employed for the purpose of programming, design, and construction of the Project. The members of the Project Team will be designated by Owner and may be modified from time to time by Owner.
- 7.1.8 **Subcontractor** means a person or entity who has an agreement with the Contractor to perform any portion of the Work. The term Subcontractor does not include the Architect/Engineer, or any person or entity hired directly by the Owner.
- 7.1.9 **Work** means the provision of all services, labor, materials, supplies, and equipment that are required of the Contractor to complete the Project in strict accordance with the requirements of the Contract and the Contract Documents. Work includes, but is not limited to, the Construction, additional work required by Change Orders, and any other work reasonably inferable from the Contract Documents. The term “reasonably inferable” takes into consideration the understanding of the parties that some details necessary for completion of the Work may not be shown on the Drawings or included in the Specifications, but they are a requirement of the Work if they are a usual and customary component of the Work or otherwise necessary for complete installation and operation of the Work.
- 7.1.10 **Worker Wage Rate** means the actual hourly wage of non-salaried persons performing work on the Project plus allowable employer contributions as established on the Worker Wage Rate Form required by the Construction Documents. Any payments made for Contractor’s and/or subcontractors’ personnel are subject to audit to determine the actual cost of the wages and allowable employer contributions incurred by the Contractor for services performed for the Project.

ARTICLE 8 - OWNER’S RESPONSIBILITIES

- 8.1 Owner will designate an Architect/Engineer or other consultant for the Project.
- 8.2 Owner will identify a person who is authorized to act on Owner's behalf with respect to the Project. This person is referred to herein as the “Project Manager”. The Owner's Project Manager will examine the documents submitted by the Contractor and will render decisions on behalf of Owner. The Project Manager will administer this Agreement on behalf of Owner, including final determination of fees and costs earned by the Contractor and equitable back charges against the Contractor.
- 8.3 Owner, at Owner’s cost, will secure the services of surveyors, geotechnical engineers, existing facility surveys, testing and balancing, environmental surveys and/or other special consultants to develop such additional information as may be necessary for the design or construction of the Project.
- 8.4 **The Contractor's attention is directed to the fact that piping, pipelines, conduit, duct banks and other underground and under-slab utilities and/or installations as may be shown on the plans have been taken from the best available information. Owner makes no representations that information provided on underground and under-slab installations is complete or accurate. There may be other subsurface and under-slab pipelines, conduit, devices or installations. The Contractor will save and hold harmless Owner from any and all suits or claims resulting from damage by his operations to any pipeline, electric or communications conduits or similar underground installation.**
- 8.5 Unless otherwise provided in the Contract Documents, Owner will secure and pay for necessary rights of way and easements required for the construction, use, or occupancy of permanent structures or for permanent changes in existing facilities.
- 8.6 Owner will arrange and pay for materials, structural, mechanical, chemical and other laboratory tests as required by the Construction Documents.

- 8.7 Owner will furnish all legal, accounting, auditing and insurance counseling services for itself as may be necessary for the Project.
- 8.8 Owner or its Architect/Engineer will furnish required information and services and will render approvals and decisions as expeditiously as is consistent with reasonable skill and care and the orderly progress of the Contractor's services and of the Work. Contractor will advise Owner of key or critical information in a timely manner in order to avoid Project delay. Owner will not be held accountable to Contractor for any delay if the Contractor failed to provide sufficient notice to Owner of key or critical information needed for approval.
- 8.9 Owner may designate one or more construction inspectors who will be given access to the Work as requested or needed. The provision of inspection services by Owner will not reduce or lessen Contractor's responsibility for quality assurance and inspection of the Work. Contractor is fully and solely responsible for constructing the Project in strict accordance with the Construction Documents.
- 8.10 Owner will have the right to reject any defective Work on the Project. Should the Contractor refuse or neglect to correct any such Work within a reasonable time after notice, Owner may have the Work corrected and recover all expenses incurred from the Contractor on demand.
- 8.11 Owner will forward all instructions to the Contractor in writing. Any verbal directions given by Owner will be confirmed in writing. No communication or direction from Owner will be interpreted as a change to the Agreement unless provided in writing and processed as a Change Order.
- 8.12 Owner will not be responsible for and will not have control or charge of construction means, methods, techniques, sequences or procedures, or for safety precautions and programs in connection with the Work. Owner will not be responsible for or have control or charge over the acts or omissions of the Contractor, Subcontractors, or any of their agents or employees, or any other person performing any of the Work. Owner will not be responsible for failure of any of the aforementioned persons to carry out the Construction Work in accordance with the Contract Documents.
- 8.13 Owner will observe the Work to evaluate the Contractor's Applications for Payment.
- 8.14 Owner's Right to Stop the Work.
- 8.14.1 If the Contractor fails to correct defective Work or persistently fails to carry out the Work in accordance with the Construction Contract, the Owner may, in writing, order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated. However, this right of Owner to stop the Work will not give rise to any duty on the part of Owner to exercise this right for the benefit of the Contractor or any other person or entity.
- 8.15 Owner's Right to Carry out the Work.
- 8.15.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Construction Contract and fails within seven (7) days after receipt of written notice from Owner to commence and continue correction of such default or neglect with diligence and promptness, Owner may, after seven (7) days following receipt by the Contractor of any additional written notice and without prejudice to any other remedy he may have, commence and correct such deficiencies. In such case, an appropriate Change Order will be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor will pay the difference to the Owner within thirty (30) days after receipt of written demand therefor.
- 8.16 Owner or Architect/Engineer will prepare Change Orders.
- 8.17 Owner will approve and monitor the Schedule.

8.18 THE OWNER'S RIGHT TO PERFORM WORK AND TO AWARD SEPARATE CONTRACTS

- 8.18.1 The Owner reserves the right to perform work related to the Project with his own forces, and award separate contracts in connection with other portions of the Project.
- 8.18.2 When separate contracts are awarded for different portions of the Project or other work on the site, the term "contractor" in the Construction Contract in each case shall mean the contractor who executes such separate agreements with the Owner for Construction Services.
- 8.18.3 The Contractor shall coordinate the Work with other contractors and with the Owner and the Owner's labor crews, if any. The Contractor must incorporate the work of the Owner and its separate contractors into the Contractor's project schedule. If information is not included in the Construction Documents, the Owner or Architect/Engineer will timely provide the Contractor with sufficient information to allow the Contractor to incorporate work by the Owner and its separate contractors into the schedule.
- 8.18.4 The Contractor shall afford the Owner and its other contractors reasonable opportunity for the introduction and storage of their materials and equipment and the execution of their work, and shall connect and coordinate his Work with theirs as required by the Construction Contract.
- 8.18.5 If any part of the Work depends for proper execution or results upon the work of the Owner or any other contractor, the Contractor shall, prior to proceeding with the Work, promptly report to the Owner and Architect/Engineer any apparent discrepancies or defects in such other work that render it unsuitable for such proper execution and results. Failure of the Contractor so to report shall constitute an acceptance of the Owner's or separate contractors' work as fit and proper to receive his Work.
- 8.18.6 Contractor may share responsibility for defective work not reported, yet known by Contractor to be deficient.
- 8.18.7 Should the Contractor wrongfully cause damage to the Work or property of the Owner, or to other work on the site, the Contractor shall promptly remedy such damage.
- 8.18.8 Should the Contractor wrongfully cause damage to the Work or property of any other contractor, the Contractor shall upon due notice promptly attempt to settle with such other contractor by agreement, or otherwise to resolve the dispute. If such separate contractor sues or initiates a proceeding against the Owner on account of any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor who shall defend such proceedings at the Contractor's expense. If any judgment or award against the Owner arises therefrom the Contractor shall pay or satisfy it and shall reimburse the Owner for all attorneys' fees and court or other costs which the Owner has incurred. The Owner shall have the right to select counsel for any such defense.

ARTICLE 9 – ARCHITECT/ENGINEER'S RESPONSIBILITIES

- 9.1 Architect/Engineer will coordinate and cooperate with Owner and Contractor to best support the progress of the Work. Architect/Engineer's authority to act on behalf of Owner is limited to that defined herein. Unless defined in its Construction Documents, Architect/Engineer will have no responsibility for construction means and methods, sequencing, logistics, phasing, procedures, safety precautions, or other attributes of the physical performance of the Work.
- 9.2 Architect/Engineer will provide administration of the Contract between Owner and the Contractor as provided herein and per the General and Supplemental Terms and Conditions, if any, of the Contract. Owner will provide Architect/Engineer with a copy of the executed contract between Owner and the Contractor, including the GCs and Supplemental Conditions of the Contract.
- 9.3 Architect/Engineer and, as appropriate to the progress of the Work, its subconsultants will attend progress meetings and make weekly site visits after the start of construction to generally determine if the Work is proceeding in accordance with the Contract Documents. Architect/Engineer will not make exhaustive or continuous on-site inspections to check the quality or quantity of the Work.
- 9.4 The purpose for Architect/Engineer's attendance at progress meetings is threefold: (i) to aid in the coordination, cooperation, and understanding of Project requirements and the resolution of conflicts as

described by the Contract Documents; (ii) to report to Owner identified or known deviations from the Contract Documents and from the most recent construction schedule submitted by the Contractor; and (iii) to observe and comment on the quality of subcontractors' work at the outset of its installation.

- 9.5 As part of its attendance at progress meetings, Architect/Engineer will participate with Owner in "1st Work" observations to observe the quality and compliance of subcontractors' work at outset of its installation. The purpose and intent is to establish an acceptable installation quality for each component of the Work at the start of such work rather than to find defective work and require its correction later.
- 9.6 Architect/Engineer will recommend rejection of Work that does not conform with Contract Documents and which cannot readily be corrected.
- 9.7 Architect/Engineer will respond to all Requests for Information (RFI) within four (4) days unless otherwise agreed in advance. This four (4) maximum duration includes reviews, collected and coordinated between all reviewing (engineering) disciplines. Architect/Engineer will endeavor to provide immediate or expedited reviews as needed and prioritized.
- 9.8 Submittals.
- 9.8.1 Architect/Engineer will review submittals in accordance with and to support Schedule. Submittals include without limitation, product data and information, shop drawings, samples, etc. In general, each submittal will be reviewed and returned to the Contractor within fourteen (14) days unless otherwise agreed in advance. This fourteen (14) day duration includes reviews, collected and coordinated between all reviewing disciplines. Reviews will be performed on incomplete submittals as needed to support construction progress. The Contractor will be required to prepare a Submittal Schedule as general guidance and to assist Architect/Engineer's planning.
- 9.8.2 Architect/Engineer will only review a particular shop drawing, product data, and samples two (2) times. Owner can recover from Contractor any costs that Architect/Engineer may have incurred for necessary additional review and Owner will withhold that amount from any payment due the Contractor pending the resolution of the matter. However, if Owner determines that Architect/Engineer's approvals have been withheld unfairly, the provisions of this sub-subparagraph will not apply.
- 9.9 Architect/Engineer will provide necessary clarifications of the Construction Documents either from its office or at the site. Services of Architect/Engineer and/or its consultants or subconsultants will be provided depending on the nature of the specific problem needing clarification.
- 9.10 Architect/Engineer will provide all interpretations of Construction Documents and details of incidental services necessary to the proper execution of the Work, including the selection of colors, textures, and finishes.
- 9.11 Architect/Engineer will participate in and aid resolution of systems conflicts and Work coordination. Such services will be provided in a timely manner to facilitate Work progress.
- 9.12 Extra work caused Architect/Engineer and its consulting engineers or subconsultants, as applicable, by the necessity for multiple repeated visits to the job site to study, direct, and observe the correction of improper Work will be paid for by the Contractor. Central Health may recover any costs from Contractor that Architect/Engineer may have otherwise pursued against Central Health for additional services described in this Subparagraph and Central Health will withhold that amount from any payment due the Contractor pending the resolution of the matter.
- 9.13 Architect/Engineer's Review of Contract Payments.
- 9.13.1 Architect/Engineer will participate and cooperate with Owner and Contractor in joint reviews of Contractor's Application of Payments. Based on Architect/Engineer's observations and evaluations

of the Contractor's Work, Architect/Engineer will review, on a monthly basis, Contractor's Applications for Payment and will certify amounts due to the Contractor. Architect/Engineer will act to protect Owner, but will act in good faith. Any corrections to the Contractor's Application for Payment will be sent to the Contractor's Project Manager and Owner's Project Manager by Architect/Engineer.

9.14 Architect/Engineer's Review of Contractor's Changes in the Work.

9.14.1 Architect/Engineer may only authorize minor changes in the Work. A minor change is a change that does not increase the cost of the Work or the time required for Contractor's performance. Minor changes will generally conform to Contract Documents.

9.14.2 Architect/Engineer will assist Owner in reviewing Contractor's proposed changes. Architect/Engineer will advise Owner on the proposed changes' impact to labor effort, materials cost, and the approved time for completion. Architect/Engineer's review will be timely, but in no event, later than ten (10) days after receipt of a request for change.

9.15 Construction Completion.

9.15.1 Upon Contractor's request for a substantial completion inspection of the Work or a portion of the Work, Architect/Engineer will make joint field observations and reviews of construction with Owner and Contractor to determine whether Contractor has completed Work in accordance with interim milestone dates or durations as defined in the Contract, if any.

9.15.2 Architect/Engineer will make a joint final field observation of construction with Owner and Contractor.

9.15.3 Architect/Engineer will prepare punch lists identifying deficiencies in the Work. Architect/Engineer will prepare one punch list for each area that is substantially complete and will perform one follow up inspection of each punch list area to confirm that identified deficiencies (from initial punch list for each area) are corrected. Architect/Engineer will also participate with Owner and Contractor in pre-punch list inspections of each type of space to establish and define minimum Work levels to be completed prior to Architect/Engineer's punch list inspections. Owner can recover from Contractor any costs that Architect/Engineer may have incurred for additional services described in this subparagraph, and Owner will withhold that amount from any payment due the Contractor pending the resolution of the matter. However, if Owner determines that Architect/Engineer's approvals have been withheld unfairly, the provisions of this sub-subparagraph will not apply.

ARTICLE 10 - CONTRACTOR'S RESPONSIBILITIES

10.1 The Contractor acknowledges that it is experienced in constructing projects substantially similar to the Project.

10.2 Except as otherwise required in the Contract Documents, Architectural and Engineering services are not included in this Contract.

10.3 Threshold inspections are not included in this Contract. However, Contractor will schedule and coordinate performance of threshold inspections, if any.

10.4 Contractor will perform the Work in strict accordance with all applicable laws, codes, rules, regulations, and any other requirements of authorities having jurisdiction over the Project in effect when the Contract is established, including any applicable rules, regulations, guidelines, and advisories promulgated by the City, County, and/or State as applicable.

10.5 Contractor expressly acknowledges that the Work called for under this Agreement and the Contract Documents may be in a geographical area prone to abnormal weather, high or excessive heat, tropical storms, and hurricanes

("Severe Weather"). Contractor recognizes that effects from Severe Weather may: (a) cause extended delays on the part of Subcontractors performing work on the Project; (b) result in labor and material shortages; (c) result in contract defaults on the part of Subcontractors; (d) result in Subcontractors not being able to honor previous prices and time commitments; (e) cause the cost of labor and materials to rise to an unknown extent, and; (f) result in other extended time and cost impacts to the Project. The Owner recognizes that the Project may necessarily be shut down for a reasonable period of time preceding, during, and following Severe Weather occurring on or near the Project. Contractor may be entitled to an increase in the Contract Sum and/or an extension of time, due to delay incurred by Contractor, occasioned by the effects of such Severe Weather. If the Project is shut down by Owner or governing authority with jurisdiction over the Project due to Severe Weather, the Contractor may be entitled to recover its reasonable, direct, documented, and tangible costs resulting from such shutdown. Contractor acknowledges that any such weather conditions will not be considered "unforeseen" conditions for the purposes of this Agreement. Contractor will comply with any hurricane policies or procedures promulgated by Owner or local or state regulatory authorities. Owner acknowledges that such policies and procedures may impact the progress of the Work.

10.6 Review of Contract Documents.

10.6.1 The Contractor will exercise due diligence in carefully studying the Contract Documents and will report to Owner, in a timely manner, any error, inconsistency, or omission he may discover. The report will be in the form of a RFI. For purposes of this paragraph, the RFI will be considered "timely" if it is provided as soon as practicable but in no event later than seven (7) days after the Contractor's discovery of the error, inconsistency or omission. Should the Contractor fail to timely report such errors, inconsistencies, or omissions in the Contract Documents and such delay results in additional costs to the Owner and/or in schedule delays, the Contractor will not be entitled to a Contract Time extension or an increase in the Contract Sum for additional Work, incidental damages, or Project delays unless the Contractor demonstrates to Owner's satisfaction that such additional costs and/or Project delays would have resulted even if the RFI had been timely issued. The Contractor will perform no portion of the Work at any time without the necessary part of the Contract Documents or, where required, approved shop drawings, product data, or samples for such portion of the Work.

10.6.2 If the Contractor observes that any of the Contract Documents are at variance with applicable laws, statutes, building codes, or regulations in any respect, he will promptly notify Owner in writing. Any necessary changes will be accomplished by appropriate Change Order.

10.7 Without limit, the Contractor will:

10.7.1 Monitor, direct, and coordinate the Work of the Subcontractors with the activities and responsibilities of the Owner, its consultants, the Architect/Engineer and Contractor to complete the Project in accordance with the Contract Documents.

10.7.2 Monitor and assess the adequacy of the Subcontractors' personnel and equipment, as well as the availability of materials and supplies to meet the schedule. Take appropriate action to ensure that Subcontractors supply sufficient manpower, material, and equipment to meet schedule and Contract requirements. Develop and maintain a project log that records, on a daily basis, the number and types of personnel and equipment on the project site for all Subcontracts. Provide Project Manager with copies of all daily project logs with summaries of such logs in monthly reports to Project Manager.

10.7.3 Promptly advise Owner if any Subcontractor is in material breach of its Contract or appears unable to perform its scope of work.

10.8 Supervision and Construction Procedures.

10.8.1 The Contractor will designate a representative authorized to act on the Contractor's behalf with respect to the Project. The designated representative will be Owner's primary contact during Construction and will be available as required for the benefit of the Project and Owner. The designated

representative will be authorized to act on behalf of and bind the Contractor in all matters related to Construction including, but not limited to, execution of Change Orders and Applications for Payment.

- 10.8.2 The Contractor will supervise and direct the Work, using his best skill and attention. He will be solely responsible for all construction means, methods, techniques, sequences and procedures, and for coordinating all portions of the Work.
- 10.8.3 The Contractor will be responsible to Owner for the acts and omissions of his employees, Subcontractors, and their agents and employees, and for other persons performing any of the Work under a contract with the Contractor.
- 10.8.4 The Contractor will not be relieved from his obligations to perform the Work either by the activities or duties of Owner or Architect/Engineer in his administration of the Contract, or by inspections, tests, or approvals required in accordance with Contract Documents by persons other than the Contractor.
- 10.8.5 In the execution of the Contract, the Contractor must comply with all applicable state and federal laws, including but not limited to laws concerned with labor, equal employment opportunity, safety and minimum wages. THE CONTRACTOR WILL MAKE HIMSELF FAMILIAR WITH AND AT ALL TIMES WILL OBSERVE AND COMPLY WITH ALL FEDERAL, STATE AND LOCAL LAWS, ORDINANCES AND REGULATIONS THAT IN ANY MANNER AFFECT THE CONDUCT OF THE WORK, AND WILL INDEMNIFY, SAVE AND HOLD HARMLESS OWNER AND ITS OFFICIAL REPRESENTATIVES AGAINST ANY CLAIM TO THE EXTENT ARISING FROM VIOLATION OF ANY SUCH LAW, ORDINANCE, OR REGULATION BY HIMSELF OR BY HIS SUBCONTRACTORS, SUPPLIERS, CONSULTANTS, OR EMPLOYEES.
- 10.8.6 The Contractor will perform all services specifically allocated to it by the Contract Documents as well as those services reasonably inferable from the Construction Documents as necessary for completion of the Work and the Project. Contractor agrees to perform these services using his best efforts, skills, judgments, and abilities.
- 10.8.7 The Contractor will organize and maintain a qualified and skilled staff as necessary for the duration of the construction Work at the Project site with clearly defined lines of authority and communication as necessary to coordinate and direct the Work, monitor the progress of the Subcontractors, and enforce and ensure quality standards in the Work...
- 10.8.8 The Contractor will cooperate with the Owner and its Architect/Engineer and will endeavor to further and protect the goals and interests of the Owner and the Project. The Contractor will complete the Project in an expeditious and economical manner consistent with the interests of Owner and in accordance with the Schedule.
- 10.8.9 The Contractor will establish procedures for communication and coordination among the Project Team, Subcontractors, separate contractors, and others with respect to all aspects of the construction of the Project, and implement such procedures.
- 10.8.10 The Contractor will establish and maintain a numbering and tracking system for all Project records, including changes, RFIs, submittals, and supplementary instructions and will provide updated records at each Owner's meeting and when requested.

10.9 Schedule

- 10.9.1 The Contractor will develop a critical path method schedule ("**Schedule**") for Project Team review and Owner approval that coordinates and integrates activities on the Project, including the Contractor's services, the Architect/Engineer's administrative and observation services, the work of other consultants and suppliers, and Owner's activities with the anticipated construction schedules for other

contractors. The Schedule must identify all major milestones through Project Final Completion. The Schedule will be created and maintained in format acceptable to Owner. Once approved by Owner, the Schedule will become the "Project Baseline Schedule." The Schedule will be provided to Owner in both electronic and hardcopy formats.

- 10.9.2 The Schedule will include other detailed schedule activities as needed for the Project or directed by Owner including, without limit, Owner-managed work under separate contracts such as long lead procurement activities and durations, furniture, fixtures and equipment, project security, property protection, life-safety systems integration with building automation and monitoring systems, telephone, information technology data-transmission systems, and computer technology systems, and other systems identified by Owner or required for the Project.
- 10.9.3 The Contractor will update the Schedule throughout the Project and in accordance with Contract Documents. Bi-weekly updates are required to track ongoing activities and to provide a "look-ahead" for subsequent Work and activities. Monthly updates will track overall Project progress. More frequent updates to track overall Project progress or specific work will be provided at Owner direction.
- 10.9.4 All schedule updates will be tracked against the approved Project Baseline Schedule. The Project Baseline Schedule will not be adjusted without Owner approval. Schedule format will clearly identify and show Project Baseline Schedule activities, milestones, durations and similar information, and progress and status compared to the Baseline.
- 10.10 Construct the Work in strict accordance with the Contract Documents within the time required by Owner approved Project Baseline Schedule.
- 10.11 Attend Owner's regularly scheduled Project progress meetings and fully advise the Project Team of the Project status including schedule, costs, quality, and changes. Prepare and issue to Owner and Architect/Engineer meeting minutes for each Project progress meeting, and other significant meetings. Issue meeting minutes within three (3) days of the meeting.
- 10.12 In addition to attending Owner's regularly scheduled Project progress meetings, the Contractor will schedule, direct, and attend interim progress meetings with other members of the Project Team as required to maintain Project progress. The Contractor will record and distribute the minutes of each interim progress meeting to each Project Team member. The minutes will identify critical activities that require action and the dates by which each activity must be completed.
- 10.13 Coordinate and accept, as required, delivery and installation of Owner-procured material and equipment.
- 10.14 Provide and pay for all labor, materials, equipment, tools, construction equipment and machinery, transportation, and all other facilities and services necessary for the proper execution and completion of the Work in strict accordance with the requirements of the Contract Documents.
- 10.15 Obtain building permits and special permits for permanent improvements as required by law or the Construction Documents. Assist Owner and Architect/Engineer in obtaining all approvals required from authorities having jurisdiction over the Project.
- 10.16 The Contractor represents and warrants to the Owner and the Architect/Engineer that all materials and equipment furnished and installed under this Contract will be new unless otherwise specified, and that the Work will be of good quality, free from faults and defects, and in strict conformance with the Construction Documents. Any portion of the Work not conforming to these requirements, including substitutions not properly approved and authorized, may be considered defective. If required by the Owner, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment. The Contractor further represents and warrants to the Owner that all items delivered, and all services rendered will conform to the Construction Documents, and will be of merchantable quality, good workmanship, and free from defects. The Contractor further agrees to provide copies of applicable warranties and guaranties, including separate manufacturer or supplier warranties or guaranties to the Owner. Copies will be provided within ten (10) days

after the Certificate of Substantial Completion is issued. Limitations or conditions in manufacturer, vendor, or subcontractor warranties do not limit or condition Contractor's warranty to Owner. Return of merchandise under warranty shall be at the Contractor's expense.

10.17 Maintain and deliver the required documents that describe changes or deviations from the Construction Documents that occurred during construction and that reflect the actual "As Built" conditions of the completed Work.

10.18 Cost Control. The Contractor will without limit:

10.18.1 Maintain cost accounting records on authorized Work performed under unit costs, actual costs for labor and materials, or other basis requiring accounting records. Provide Owner access to these records and preserve them for a period of three (3) years after final payment, or as may be required by Owner due to continuing audit or discrepancies, litigation or similar issue, or as required by bonding or other agencies.

10.18.2 The Contractor is required to pay not less than the wage scale of the various classes of labor as shown on the "Prevailing Wage Schedule" provided by the Owner. The specified wage rates are minimum rates only, and the Contractor is encouraged to pay all laborers, workmen, and mechanics employed on this job no less than the living wage as established by Travis County at the time of contract award, even if the living wage exceeds the wages set forth in the minimum wage scale. However, the Owner will not consider any claims for additional compensation made by the Contractor because of payment by the Contractor of any wage rates in excess of the applicable minimum rate contained in the Prevailing Wage Schedule.

10.18.3 Pursuant to the provisions of Chapter 2258 of the Texas Government Code Texas Civil Statutes, the Owner shall, subject to a final resolution of the matter, withhold an amount necessary to compensate the workers at the statutory wage rate and a penalty of sixty dollars (\$60.00) for each laborer, workman or mechanic employed, for each calendar day, or portion thereof, if such laborer, workman or mechanic is paid less than the said stipulated minimum rates for any work done under the Construction Contract, by him, or by any subcontractor under him. The Contractor and each Subcontractor shall keep, or cause to be kept, an accurate record showing the names and occupations of all laborers, workmen and mechanics paid less than the said stipulated minimum rates for any work done under the Construction Contract, by him, or by any subcontractor under him. The Contractor and each Subcontractor shall keep, or cause to be kept, accurate records showing the names and occupations of all laborers, workmen and mechanics employed in connection with the Work, and showing also the actual per diem wages paid to such workers, which record shall be open at all reasonable hours for the inspection by the Owner.

10.18.4 Certain public works require under the minimum wage schedule to list not only "Building Construction" wage rates but also "Incidental Paving and Utilities" wage rates. The Contractor's attention is called to the fact that all classes of work within the area of the building shall be paid "Building Construction" wage rates. A set of the applicable labor rates for public works projects is set forth in the Bidding Documents.

10.19 Quality Control. The Contractor will develop and implement a Quality Control Program for the purpose of preventing, tracking, and correcting deficiencies in the Work.

10.19.1 Contractor will require each Subcontractor to demonstrate initial work methodology, sequence, and quality as requested by Owner, Architect/Engineer, or as required by Contract Documents. Rejected work will immediately be removed or re-worked and re-constructed until accepted by Owner and the Architect/Engineer. Approved initial work may be included in the final work.

10.19.2 The Contractor will inspect the Work of Subcontractors and material suppliers to guard Owner against defects and deficiencies in the Work. The Contractor will check and report on all materials, equipment, systems, and related items to be incorporated in the Work, including, but not limited to, compliance with Construction Documents and verification of specific conformance to approved coordination drawings, certifications, shop drawings, submittals, mock-ups and similar items. Subcontractors and

material vendors will immediately be notified of identified deficiencies. All deficiencies will be added to and tracked in a quality deficiencies report and included in monthly reports to Owner. Deficiency reports will also be available for review and discussion in Progress Meetings. Inspections will be performed on- or off-site as required. Inspections will be handled as a General Conditions Cost item and the cost will be included in the Guaranteed Maximum Price. The Contractor will arrange for and coordinate inspection of the Work and materials by independent testing agencies in accordance with Contract Documents.

10.19.3 Contractor will promptly correct any defective Work at Contractor's sole expense, unless the Owner specifically agrees to accept the Work. Contractor will define corrective actions to be taken and provide schedules for related work. Corrective work will not be delayed unless Contractor receives Owner's approval to delay.

10.20 Reports and Project Site Documents. The Contractor will:

10.20.1 Record the progress of the Project and submit monthly, written progress reports to Owner and the Architect/Engineer including information on the Subcontractors' Work, the percentages of completion, and any other significant items and problems.

10.20.2 Keep a daily log of the progress of the Work, significant problems and accomplishments, etc. All daily reports will be available to Owner and the Architect/Engineer. The cost of all Project reporting will be a General Conditions Cost and included in the Contract Sum.

10.20.3 Take photographs to document existing site conditions, including those immediately adjacent to the Project site prior to the start of Work, and deliver a copy of such photographs to Owner. The Contractor will, at monthly intervals, take progress photographs. Progress photographs will be sufficient to encompass the entire Project site and provide visual detail of ongoing work. To the greatest extent possible, the photographs will be taken from the same vantage points as the previous month, subject to the varying opportunities and limitations of the site. Aerial photographs are not required. Digital photographs are acceptable, with electronic media containing photographs provided monthly to Owner and Architect.

10.20.4 Maintain at the Project Site records of all contracts, and a clean, dry, current, corrected, and bound set of Contract drawings. Also maintain bound specifications, shop drawings, submittals, certifications, operating manuals, warranties, and any other documents and revisions thereto that arise out of this Contract or the Work as further defined in the Contract Documents. Regularly post, correct, annotate, and update these documents to maintain records of both changes made by Owner and/or Architect/Engineer and to record As-Built conditions known by the Contractor. Owner may review these documents on a monthly basis to determine compliance with this section. The Architect, Owner, and Owner's testing, inspection and commissioning consultants will be able to rely upon the completeness and accuracy of these documents in order to perform their services.

10.20.5 Owner and Architect will have full and complete access to all Project documents prepared, maintained, and retained by the Contractor.

10.21 The Contractor will initiate, maintain, and supervise all safety precautions and programs in connection with the Work. The safety program will comply with all applicable requirements of the Occupational Safety and Health Act of 1970, all other applicable federal, state and local laws and regulations, and the Contract Documents.

10.21.1 The Contractor will provide, determine, and assign responsibilities for Site safety precautions and programs, temporary Project facilities, and equipment, materials, and services for common use of the Subcontractors. Contractor will verify that appropriate safety provisions are included in the Construction Documents.

10.22 Records and Confidentiality.

- 10.22.1 Records of Contractor's costs, reimbursable expenses pertaining to the Project and payments will be available to Owner or its authorized representative during business hours and will be retained for three (3) years after Final Payment or abandonment of the Project, unless Owner otherwise instructs Contractor in writing.
- 10.22.2 The Contractor will maintain appropriate accounting records of costs, expenses, and payrolls of employees working on the Project, for a period of three (3) years after final payment for completed services and all other pending matters concerning this Contract have been closed.
- 10.22.3 The Contractor will maintain information created, sent, or received under this Contract in accordance with all applicable laws and regulations.
- 10.23 Illegal Dumping. The Contractor will ensure that it and all of its Subcontractors and assigns prevent illegal dumping of litter in accordance with Title 5, *Texas Health and Safety Code*, Chapter 365.
- 10.24 The Contractor shall promptly correct all Work rejected by the Architect/Engineer or the Owner as defective or as failing to conform to the Construction Documents whether observed before or after Substantial Completion and whether or not fabricated, installed, or completed. The Contractor shall bear all costs of correcting such rejected Work, including any and all additional costs incurred by the Owner as a result thereof.
- 10.24.1 If any of the Work is found to be defective or not in accordance with the Construction Documents, the Contractor shall correct it promptly after receipt of a written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such specific condition. This obligation shall survive termination of the Construction Documents. The Owner shall give such notice within ten (10) days after discovery of the condition.
- 10.24.2 The Contractor shall remove from the site all portions of the Work which are defective or non-conforming and which have not been corrected under subparagraphs 10.24.1 unless removal is waived in writing by the Owner.
- 10.24.3 If within one year after the date of Substantial Completion or such longer period of time as may be prescribed by law or regulations or by the terms of any special guarantees or warranty required by the Construction Documents, any Work is found to be defective, the Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions: (i) correct such defective Work or, if it has been rejected by Owner, remove it and replace it with Work that is not defective, and (2) satisfactorily correct and remove and replace any damage to other Work or the work of others resulting therefrom.
- 10.24.4 Nothing contained in this Section 10.24 shall be construed to establish a period of limitation with respect to any other obligation which the Contractor might have under the Construction Documents, including Section 10.16 hereof. The establishment of the specific obligation of the Contractor to correct the Work has no relationship to his obligation to comply with the Construction Documents, nor to proceedings which may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the Work.

ARTICLE 11 - DISPUTE RESOLUTION

- 11.1 Definition of Dispute. "**Dispute**" means any and all disagreements, questions, claims, or controversies arising out of or relating to this Contract, including the validity, construction, meaning, performance, effect, or breach of the Contract.
- 11.2 The Project Manager or his designee acts as the Owner representative in the issuance and administration of this Construction Contract. In the case of a dispute, any document, notice, or correspondence not issued by

or to the Purchasing Manager, or other authorized Owner person, is void unless otherwise stated in this Contract. If Contractor does not agree with any document, notice, or correspondence issued by the Purchasing Manager, or other authorized Owner person, Contractor must submit a written notice to the Project Manager within ten (10) days after receipt of the document, notice, or correspondence, outlining the exact point of disagreement in detail. If the matter is not resolved to Contractor's satisfaction, Contractor may submit a Notice of Appeal to the Owner or Project Manager, if the Notice is submitted within ten (10) days after receipt of the unsatisfactory reply. Contractor then has the right to be heard by Commissioners Court.

- 11.3 Negotiation. In the event of a Dispute between the parties, the parties will promptly and in good faith attempt to resolve the Dispute at the Project level through informal negotiation. A disputing party will give written notice of the Dispute to the other party that will contain a brief statement of the nature of the Dispute. If the parties are unable to resolve the Dispute within thirty (30) days of the adverse party's receipt of the initial written notice of Dispute, the parties will endeavor to convene a meeting between senior level decision-makers not previously engaged in the Dispute. If the parties are unable to resolve the Dispute at the senior level decision maker level within thirty (30) days of the failure to resolve the Dispute at the Project level, the parties agree to submit the Dispute to mediation as set forth herein.

ARTICLE 12 – CONTRACT SUSPENSION AND TERMINATION

12.1 Suspension.

12.1.1 Owner may suspend performance under this Contract as described in Sections 12.2 and 12.3 below by giving Contractor written Notice of Suspension (a "Notice of Suspension"). The "Effective Date of Suspension" will be, in the case of Suspension of Work for Cause, the date that Owner issues the Notice of Suspension and, in the case of Suspension of Work without Cause, seven (7) days after Owner issues the Notice of Suspension. Suspension will not result in termination of this Contract, and performance may be resumed in full force and effect within sixty (60) days of receipt by Contractor of written notice of reinstatement from Owner. Upon the Effective Date of Suspension, Contractor will follow the procedures described below:

12.1.2 Contractor will immediately phase out and discontinue all Work and will prepare a statement detailing the Work performed under this Contract prior to the Effective Date of Suspension. The statement will support Contractor's final Application for Payment for the Work that will be submitted and processed in accordance with Contract Documents.

12.1.3 Contractor will make the Work site secure and demobilize and remove or otherwise secure all tools and equipment. Owner will not be invoiced or responsible for any tools or equipment remaining on site during the Suspension period. Any and all project specific materials will be protected and secured to Owner's approval. With Owner approval, temporary utilities may remain connected.

- 12.2 Suspension of Work for Cause. Owner may, at any time without prior notice, suspend all or any part of the Work, if, in the Owner's sole discretion, it is considered reasonably necessary to do so to prevent or correct any condition of the Work which constitutes an immediate safety hazard or which may reasonably be expected to impair the integrity, usefulness, or longevity of the Work when completed. Owner will give the Contractor a written notice of suspension for cause, setting forth the reason for the suspension and identifying the Work to be suspended. Upon receipt of such notice, the Contractor will immediately stop the Work so identified. As soon as practicable following the issuance of such a notice, Owner will initiate and complete an investigation of the circumstances giving rise to the suspension and will issue a written determination of their cause.

12.2.1 The Contractor will not be entitled to an extension of time or compensation for delay resulting from a suspension if Owner's investigation determines that the cause was within the control of the Contractor. If the cause is determined not to have been within the control of the Contractor, and the suspension prevents the Contractor from completing the Work within the Contract Time, the suspension is an Excusable Compensable Delay. Suspension of Work under this provision will be no longer than reasonably necessary to identify and remedy the conditions giving rise to the suspension.

12.3 Suspension of Work for Owner's Convenience. Upon seven (7) business days' prior written notice to the Contractor, Owner may at any time without breach of the Construction Contract suspend all or any portion of the Work for a period of up to sixty (36) days for its own convenience. A Notice of Suspension issued by Owner will set forth the number of days for which the Work, or any portion of it, will be suspended, and the date on which the suspension of Work will cease. When such a suspension prevents the Contractor from completing the Work within the Contract Time, it will be an Excusable Compensable Delay. A Notice of Suspension may be modified by the Owner at any time. If Owner suspends the Work for its convenience for more than sixty (60) consecutive days, the Contractor may elect to terminate the Construction Contract pursuant to the provisions of this Article.

12.3.1 If the Project is suspended or abandoned in whole or in part for convenience for more than ninety (90) consecutive days, the Contractor will be compensated for Work performed prior to receipt of written notice from Owner of such suspension or abandonment. If the Project is resumed after being suspended for more than ninety (90) consecutive days, the Contractor's compensation may be equitably adjusted if, in the Owner's reasonable opinion, such adjustment is warranted.

12.4 Owner Termination.

12.4.1 If the Contractor is declared bankrupt by a court of competent jurisdiction, makes a general assignment for the benefit of his creditors, or if a receiver is appointed on account of his insolvency, or if he persistently or repeatedly refuses or fails, except in cases for which extension of time is provided, to supply enough properly skilled workmen or proper materials, or if he fails to make prompt payment to Subcontractors or to third parties for materials or labor, or persistently disregards laws, ordinances, rules, regulations, or order of any public authority having jurisdiction, or otherwise is guilty of a substantial violation of a provision of the Contract Documents, then Owner may, without prejudice to any right or remedy and after giving the Contractor and his surety, if any, seven (7) days' written notice, terminate the employment of the Contractor and take possession of the site and all materials, equipment, tools, construction equipment, and machinery thereon owned by the Contractor and may finish the Work by whatever method he may deem expedient. In such case, the Contractor will not be entitled to receive any further payment until the Work is finished.

12.4.2 If the cost to complete the Work exceeds the unpaid balance of the Contract Sum the Contractor will pay the difference to the Owner. The amount to be paid to the Contractor or to Owner, as the case may be, will be approved by Owner, upon application, in the manner provided in Article 6, and this obligation for payment will survive the termination of the Construction Contract.

12.5 Termination for Default.

12.5.1 Failure by either party in performing any material provisions will be a breach of contract, in which case, either party may require corrective action within ten (10) days after the date the breaching party receives written notice from the non-breaching party that cites the exact nature of the breach. Failure to take corrective action or failure to provide a satisfactory written reply excusing failure to take corrective action within the prescribed ten (10) days will constitute default. The defaulting party will be given a twenty (20) day period within which to show cause why the Construction Contract should not be terminated for default. The Contractor's surety will be copied on any notices to the Contractor and will be required at any meeting with the Contractor to discuss the default and any recovery plan. Owner may take whatever action are in its best interests. All notices of a breach(s) by the Contractor will be issued by the Purchasing Manager or Owner's legal representative only, and all replies from the Contractor will be made in writing to the Purchasing Manager or Owner's legal representative at the address provided herein. Notices issued to anyone other than the Purchasing Manager or Owner's legal representative will be void, and will be considered as not having been issued or received. The defaulting party will be liable for actual damages as stipulated in this Contract. Liquidated damages, if specified in the Contract, may also apply. Owner may also enforce the performance of this Contract in any manner allowed by law in the event of breach or default, and may contract with another party without further notification to the Contractor. At a minimum, the Contractor will be required to pay

any difference in the cost of securing the products or services covered by this Contract from another source because of Contractor's default, plus reasonable administrative costs. If termination for default occurs, Owner and its officials, agents, and representatives will not be liable for loss of any profits anticipated to be made from this Contract.

12.6 Termination for Convenience.

- 12.6.1 Owner reserves the right to terminate this Agreement for reasons other than default by Contractor, including for any reason deemed by Owner to serve the public interest, or resulting from any governmental law, ordinance, regulation, or court order, by delivering to Contractor a written notice (a "Notice of Termination for Convenience"), which will take effect on the third (3rd) day following receipt by Contractor ("Termination for Convenience"). In the event of Termination for Convenience, Owner and its officials, agents and representatives will not be liable for loss of any profits or opportunity costs.
- 12.6.2 Upon receipt of a Notice of Termination for Convenience and prior to the effective date of termination, Contractor will, unless the Notice of Termination for Convenience otherwise directs, immediately phase out and stop all Work in connection with the project and this Contract, and will proceed to promptly cancel all existing orders and contracts insofar as such orders and contracts are chargeable to this Agreement. Within thirty (30) days after receipt of a Notice of Termination for Convenience, the Contractor will submit an Application for Payment detailing the Work performed under this Agreement prior to the effective date of termination.
- 12.6.3 Upon satisfaction of the above conditions, Owner will pay the Contractor for approved services actually performed under this Contract prior to termination, less previous payments.
- 12.6.4 In the event of a no-cause termination (i.e., termination for Owner's convenience), the Contractor will be entitled to compensation for all services performed prior to the termination date, provided however, the Contractor has delivered to Owner such statements, accounts, reports, and other materials as required hereunder together with all reports, documents, and other materials prepared by the Contractor prior to termination. Upon such payment, Owner will have no further obligation to the Contractor.
- 12.6.5 Termination of this Contract will not relieve the Contractor or any of its employees, Subcontractors, or consultants of liability for violations of this Contract or for any act or omission, including negligence, of the Contractor related to the Project.

ARTICLE 13 - INDEMNITY

ARISING OUT OF OR RESULTING FROM ANY ACT OR OMISSION OF THE CONTRACTOR, ANY SUBCONTRACTOR, SUPPLIER, ANYONE DIRECTLY OR INDIRECTLY EMPLOYED BY ONE OR ALL OF THEM, OR ANYONE FOR WHOSE ACTS THE CONTRACTOR OR ITS SUBCONTRACTOR MAY BE LIABLE FOR, REGARDLESS OF WHETHER THE CLAIM, LOSS, CAUSE OF ACTION, SUIT, JUDGMENT, DAMAGE, OR EXPENSE IS CAUSED IN PART BY A PARTY INDEMNIFIED HEREUNDER.

- 13.1 In any and all claims against Owner or any of their agents or employees by any employee of the Contractor, any Subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts either of them may be liable, the indemnification obligation under this paragraph will not be limited in any way by any limitation in the amount or type of damages or by compensation or benefits payable by or for the Contractor or any Subcontractor under workers' or workmen's compensation acts, disability benefits acts, or other employee benefit acts.
- 13.2 The Contractor's indemnification obligations hereunder will not extend to any claim, damage, loss, cause of action, suit, judgment, expense, or liability incurred by Owner or the Architect/Engineer and that results

primarily from the negligent preparation of the signed and sealed professional services work product provided for the Project.

- 13.3 PATENT AND COPYRIGHT INFRINGEMENT. CONTRACTOR WILL ALSO INDEMNIFY AND HOLD OWNER, ITS DIRECTORS, OFFICERS, AGENTS, CONSULTANTS, AND EMPLOYEES, HARMLESS FROM AND AGAINST ALL CLAIMS, LOSSES, CAUSES OF ACTION, SUITS, PROCEEDINGS, JUDGMENTS, COSTS, EXPENSES, AND LIABILITIES OF EVERY KIND, ARISING FROM INFRINGEMENT OR ALLEGED INFRINGEMENT OF ANY UNITED STATES PATENT OR COPYRIGHT THAT ARISE OUT OF ANY OF THE WORK PERFORMED BY THE CONTRACTOR OR THE CONTRACTOR'S USE OF, OR DIRECTION TO OWNER TO USE, ANY ARTICLE OR MATERIAL PROTECTED BY PATENT OR COPYRIGHT LAW ("PROTECTED MATERIALS"). UPON BECOMING AWARE OF A SUIT OR THREAT OF SUIT FOR PATENT OR COPYRIGHT INFRINGEMENT, OWNER WILL PROMPTLY NOTIFY THE CONTRACTOR AND THE CONTRACTOR WILL BE GIVEN FULL OPPORTUNITY TO NEGOTIATE A SETTLEMENT. THE CONTRACTOR DOES NOT WARRANT AGAINST INFRINGEMENT BY REASON OF OWNER'S OR ARCHITECT/ENGINEER'S DESIGN OR BY THEIR USE OF PROTECTED MATERIAL IN COMBINATION WITH OTHER MATERIALS OR IN THE OPERATION OF ANY PROCESS. IN THE EVENT OF LITIGATION, OWNER AGREES TO COOPERATE REASONABLY WITH CONTRACTOR AND PARTIES WILL BE ENTITLED, IN CONNECTION WITH ANY SUCH LITIGATION, TO BE REPRESENTED BY COUNSEL OF THEIR OWN CHOICE.
- 13.4 Duty to Defend. The Contractor will and does agree to defend Owner in all suits or proceedings that relate to any obligation under this Contract for which Contractor has agreed to indemnify Owner. The Contractor will undertake the defense of Owner at no cost to and in coordination with counsel for Owner, and the Contractor acknowledges that Owner is entitled to participate in the selection of counsel. Owner may defend a nonparty claim with counsel of its own choosing and without Contractor's participation if (1) the Contractor notifies Owner that it does not wish to defend the nonparty claim by midnight at the end of the tenth (10th) day after Owner notifies Contractor of the claim, (2) the Contractor fails to notify Owner of its desire to defend the nonparty claim within the same time period, (3) representation of the Contractor and Owner by the same counsel would, in the opinion of counsel, constitute a conflict of interest, or (4) Contractor fails to diligently and continuously conduct its defense of Owner. The costs incurred by Owner in undertaking its own defense, including but not limited to Attorneys' Fees, will constitute a portion of the indemnification duties set forth in this Agreement.
- 13.5 Claims Notification. If Contractor receives notice or becomes aware of any claim, or other action, including proceedings before an administrative agency, that is made or brought by any person, firm, corporation, or other entity against the Contractor or Owner, the Contractor will give written notice to Owner of: the claim or other action within three (3) business days after being notified of it or the threat of it; the name and address of the person, firm, corporation or other entity that made or threatened to make a claim, or that instituted or threatened to institute any type of action or proceeding; the basis of the claim, action or proceeding; the court or administrative tribunal, if any, where the claim, action, or proceeding was instituted; and the name or names of any person against whom this claim is being made or threatened. This written notice will be given in the manner provided by this Contract. Except as otherwise directed, the Contractor will furnish to Owner copies of all pertinent papers received by the Contractor with respect to these claims or actions.
- 13.6 The indemnities contained herein will survive the termination of this Contract for any reason whatsoever.

ARTICLE 14 - SPECIAL WARRANTIES

- 14.1 Notwithstanding anything to the contrary contained in this Contract, Owner and the Contractor agree and acknowledge that Owner is entering into this Contract in reliance on Contractor's represented expertise and ability to provide construction services. The Contractor agrees to use its best efforts, skill, judgment, and abilities to perform its obligations and to further the interests of Owner in accordance with Owner's requirements and procedures.
- 14.2 The Contractor represents and agrees that it will perform its services in accordance with the usual and customary standards of Contractor's profession or business and in compliance with all applicable national, federal, state, municipal, laws, regulations, codes, ordinances, orders and with those of any other body having

jurisdiction over the Project. The Contractor agrees to bear the full cost of correcting his negligent or improper work and services, those of its Subcontractors, and any harm caused by the negligent or improper work or services performed by Contractor or its Subcontractors.

- 14.3 The Contractor's duties will not be diminished by any approval by Owner nor will the Contractor be released from any liability by any approval by Owner, it being understood that Owner is ultimately relying upon the Contractor's skill and knowledge in performing the services required hereunder.
- 14.4 The Contractor represents and warrants that all persons connected with the Contractor and who are directly in charge of its services are duly registered and/or licensed under the laws, rules, and regulations of any authority having jurisdiction over the Project if registration is required.
- 14.5 The Contractor agrees to advise Owner of anything of any nature in any Construction Documents and plans, sketches, instructions, information, requirements, procedures, and other data supplied to the Contractor (by Owner or any other party) that is, in its opinion, unsuitable, improper, or inaccurate for the purposes for which the document or data is furnished.
- 14.6 The Contractor agrees to perform its services under this Contract in an expeditious and economical manner, consistent with good business practices, and the interests of Owner.
- 14.7 The Contractor represents and warrants that there are no obligations, commitments, or impediments of any kind that will limit or prevent performance of its obligations under this Agreement.
- 14.8 The Contractor represents and warrants that the individual executing this Contract on behalf of Contractor has been duly authorized to act for and to bind Contractor to its terms.
- 14.9 Except for the obligation of Owner to pay the Contractor certain fees, costs, and expenses pursuant to the terms of this Contract, Owner will have no liability to the Contractor or to anyone claiming through or under the Contractor by reason of the execution or performance of this Contract. Notwithstanding any obligation or liability of Owner to the Contractor, no present or future partner or affiliate of Owner or any agent, officer, director, employee, or consultant of Owner, or anyone claiming under or through Owner has or will have any personal liability to the Contractor or to anyone claiming through or under the Contractor by reason of the execution or performance of this Contract.
- 14.10 Debarment, Suspension and Other Responsibility Matters. Certification under this Section provides for compliance with certification requirements under 15 C.F.R. Part 26, "Government-wide Debarment and Suspension." By signing this Contract, the Contractor hereby certifies that, to the best of its knowledge and belief, it:
 - 14.10.1 Is not presently debarred suspended, proposed for debarment, declared ineligible or voluntarily excluded from covered transactions by any Federal department or agency;
 - 14.10.2 Has not within a three-year (3) period preceding this Contract been convicted of or had a civil judgment rendered against it for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, City of Austin or Travis County, Texas) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
 - 14.10.3 Is not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, City of Austin or Travis County, Texas) with commission of any of the offenses enumerated in 16.33.2; and
 - 14.10.4 Has not within a three-year (3) period preceding this Contract had one or more public transactions (Federal, State, City of Austin or Travis County, Texas) terminated for cause or default.

ARTICLE 15 – NOT USED

ARTICLE 16 - MISCELLANEOUS PROVISIONS

- 16.1 This Contract does not create and will not be construed as creating an employer/employee relationship, a partnership, or a joint venture unless otherwise negotiated and defined in a final agreement. The Contractor's services are and will remain throughout the term of this Contract those of an independent contractor. The Contractor agrees and understands that the Contractor is not and will not be entitled to any of the rights and privileges established for Owner's employees. Both parties expressly acknowledge and agree that none of the Contractor's employees have a contractual relationship with the Owner.
- 16.2 Assignment. This is a Contract for construction services, and the Contractor's interest in this Contract, duties hereunder, and/or fees due hereunder may not be assigned or delegated to a third party without specific Owner approval. Any assignment of this Contract without the Owner's prior approval is void. Owner may assign this Contract upon giving the Contractor fourteen (14) calendar days advance notice. It is acknowledged by the Contractor that no officer, agent, employee or representative of Owner has any authority to assign any part of this Contract unless expressly granted that authority by Owner's Purchasing Manager.
- 16.4 Binding Contract. This Contract will be binding upon the successors, assigns, administrators, and legal representatives of the parties to this Contract.
- 16.5 Entire Agreement/Modifications. This Contract supersedes all prior agreements, written or oral, between the Contractor and Owner and will constitute the entire agreement and understanding between the parties with respect to the Project. This Contract and each of its provisions will be binding upon the parties and may not be waived, modified, amended or altered except by a writing signed by the Contractor and Owner.
- 16.6 Headings. Headings and titles at the beginning of the various provisions of this Contract have been included only to make it easier to locate the subject matter covered by that provision or subsection and will not be used in construing this Contract.
- 16.7 Gender and Number. Words of any gender in this Contract will be construed to include any other gender, and words in either singular or plural form will be construed to include the other unless the context in the Contract clearly requires otherwise.
- 16.8 Conflicts among Documents. Contractor understands and agrees that, if a conflict is found to exist between the provisions of this Contract and any provision in a related RFP, RFQ or Proposal, the provisions within the final Contract will prevail.
- 16.9 Computation of Time. When any period of time is stated in this Contract, the time will be computed to exclude the first day and include the last day of period. If the last day of any period falls on a Saturday, Sunday, or a day that Owner has declared a holiday for its employees, the last day is the next business day that is not an Owner observed holiday. Any reference to "days" will mean calendar days unless otherwise stipulated.
- 16.10 Governing Law and Venue. This Contract and all of the rights and obligations of the parties and all of the terms and conditions hereunder will be construed, interpreted, and applied in accordance with and governed by and enforced under the laws of the State of Texas without reference to its conflicts of law provisions. Venue for any legal action arising from or related to this Contract or the Project will be in Travis County, Texas.
- 16.11 Waivers. No delay or omission by either party in exercising any right or power arising from non-compliance or failure of performance by the other party will impair or constitute a waiver of any such right or power. A waiver by either party of any covenant or condition of this Contract will not be construed as a waiver of any subsequent breach of that or of any other covenant or condition of the Contract.
- 16.12 Force Majeure. The parties acknowledge that this Agreement is being executed and will be performed during, or immediately following the termination of, a Declared Disaster resulting from the COVID-19 pandemic and expressly acknowledge that they have taken the effects of this Declared Disaster and its aftermath into account

in determining timelines and performance requirements stated in it and that this Declared Disaster or any subsequent disaster declaration concerning COVID-19 may not be used to excuse performance under this Contract. Neither party is financially liable to the other for any delays or failures in contract performance caused by federal or state laws or the rules, regulations, or orders of any public body or official purporting to exercise authority or control respecting the operations covered by this Contract, or caused by strikes not against the parties, actions of the elements, or acts of God and delays due to the above causes shall not be considered a breach of this Contract. These delays or failures to perform extend the period of performance for a period of time equal to the subsistence of the impossible conditions. If Force Majeure conditions exist, the party affected by them shall give the other party Notice within five working days after the conditions begin. If timely Notice is impractical due to the Force Majeure conditions, then the party must provide Notice in as timely a manner as practicable. If Notice is not provided timely, the party experiencing Force Majeure waives it as a defense.

- 16.13 No Third-Party Beneficiary. No provision of this Contract is intended to benefit any person or entity, nor will any person or entity not a party to this Contract have any right to seek to enforce or recover any right or remedy with respect hereto.
- 16.14 Appointment. Owner hereby expressly reserves the right from time to time to designate by notice to the Contractor a representative to act partially or wholly for Owner in connection with the performance of Owner's obligations. The Contractor will act only upon instructions received from the designated representative(s) unless otherwise specifically notified to the contrary.
- 16.15 Severability. Should any term or provision of this Contract be held invalid or unenforceable in any respect, the remaining terms and provisions will not be affected, and this Contract will be construed as if the invalid or unenforceable term or provision had never been included.
- 16.16 Conflict-of-Interest. The Contractor will complete the Conflict-of-Interest Questionnaire ("Questionnaire"), attached to this Contract as Attachment A, as required by Chapter 176 of the Local Government Code, and submit it together with this signed Contract. The Contractor will also complete the Disclosure of Interested Parties Form ("Form 1295"), attached to this Contract as Attachment I, which pursuant to Section 2252.908 of the Texas Government Code, must be filed with the Texas Ethics Commission no later than thirty (30) days after the execution of this Contract. (An electronic version of this Form 1295 is available here: https://www.ethics.state.tx.us/whatsnew/elf_filing_info.htm.) The Contractor will update this Questionnaire and Form 1295 if any statement on either document becomes incomplete or inaccurate. The updated document(s) must be submitted to Owner's Purchasing Manager, 1111 E. Cesar Chavez, Austin, Texas 78702, no later than the seventh (7th) business day after the date on which the Contractor becomes aware of an event that makes a statement in either of these documents incomplete or inaccurate.
- 16.17 Solicitation. The Contractor warrants that no persons or selling agency was or has been retained to solicit this Contract upon an understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial selling agencies maintained by the Contractor to secure business. For breach or violation of this section, Owner will have the right to terminate this Contract without liability or to deduct from the Contract price or otherwise recover the full amount of such commission, percentage, brokerage or contingent fee.
- 16.18 Gratuities. Owner may terminate this Contract if it is found that gratuities of any kind were offered or given by the Contractor or any agent or representative to any official or employee of Owner with a view towards securing favorable treatment with respect to this Contract. In the event this Contract is terminated by Owner pursuant to this provision, Owner will be entitled, in addition to any other rights and remedies, to recover compensatory damages from the Contractor using the standard measure of damage calculation. The Contractor's employees, officers and agents will neither solicit nor accept gratuities, favors or anything of monetary value from Subcontractors or potential Subcontractors. The Contractor will establish safeguards to prohibit its employees from using their positions for a purpose that is or gives the appearance of being motivated by a desire for private gain for themselves or others, particularly those with whom they have family, business or other ties.

- 16.19 Funding Out. Despite anything to the contrary in this Contract, if, during budget planning and adoption, Owner fails to provide funding for this Contract for the following Owner fiscal year, Owner may terminate this Contract by giving the Contractor thirty (30) days written notice that this Contract is terminated due to the failure to fund it.
- 16.20 Owner Access and Audit. During the term of this Contract and for a period of three (3) years following termination of this Contract, Owner maintains the right to review and audit any of the books and records of the Contractor relating to the Contractor's performance and receipt of payments under this Contract. Owner may conduct its review or audit through its own employees, agents, or representatives or through independent external auditors or representatives retained by Owner. Owner will conduct such review or audit upon reasonable notice to the Contractor, at its own expense, and during regular business hours. The records will be retained beyond the third year if an audit is in progress, the findings of a completed audit have not been resolved satisfactorily, or litigation involving this Contract is not finally resolved.
- 16.21 Amendments. This Contract may be amended only by an instrument in writing that is signed by both parties. Amendments to this Contract will be effective as of the date stipulated therein. The Contractor acknowledges that no Owner officer, agent, employee, or representative has any authority to amend this Contract unless expressly granted that specific authority by Owner's Board of Managers.
- 16.22 Non-Waiver of Default. Neither failure nor delay on the part of Owner to exercise any right, remedy, power, or privilege available to it for Contractor's breach will operate as will a waiver of any preceding or succeeding breach of the same or any other provision, covenant, or condition, nor will any single or partial exercise of any right, remedy, power, or privilege preclude any other or future exercise by Owner of its rights, remedies, powers, or privileges. Moreover, any waiver to keep or perform any provision, covenant, or condition of this Contract will be deemed to be a waiver of.
- 16.23 Nondiscrimination: The Contractor will not discriminate on the grounds of race, color, or national origin in the selection and retention of Subcontractors or suppliers of materials and leases of equipment.
- 16.24 Solicitations for Subcontracts, Including Procurements of Materials and Equipment: In all solicitations either by competitive bidding or negotiation made by the Contractor for Work to be performed under a subcontract, including procurements of materials or equipment leases, each potential Subcontractor or supplier will be notified by the Contractor of the Contractor's obligations under this Contract and the sections relative to nondiscrimination on the grounds of race, color, or national origin.
- 16.25 Sanctions for Noncompliance: If the Contractor does not comply with the nondiscrimination provisions of this Contract, Owner may impose the sanctions that it determines are appropriate, including, but not limited to, withholding payments to Contractor under the Contract until Contractor complies, or until termination or suspension of the Contract, in whole or in part.
- 16.26 Incorporation of Provisions: The Contractor will include the provisions regarding nondiscrimination in every subcontract, including procurements of materials and leases of equipment, unless exempt by the regulations, or directives issued pursuant to them.
- 16.27 Public Information Act. Owner is subject to the provisions of the Texas Public Information Act ("PIA"). If Owner receives a request for disclosure of any information related to the good or services provided under this Contract or for information provided to Owner under this Contract that constitutes a record under the PIA, the information must qualify for an exception provided by the PIA to be withheld from public disclosure. The Contractor authorizes Owner to submit any information provided under the Contract or otherwise requested to be disclosed, including information that the Contractor has labeled as confidential or proprietary, to the Office of the Texas Attorney General for a determination as to whether any such information may be accepted from public disclosure under the PIA. If Owner does not have a good faith belief that information may be subject to an exception to disclosure under the PIA, Owner is not obligating itself by this Contract to submit the information to the Attorney General for a determination. Owner will have no obligation or duty to advocate the confidentiality of the Contractor's material to the Attorney General or to any other person or entity. It is the Contractor's responsibility and obligation to make any legal argument to the Attorney General or court of

competent jurisdiction regarding the exception of the information in question from disclosure. The Contractor waives any claim against and releases from liability Owner, its officers, directors, employees, agents, and attorneys with respect to disclosure of information provided under this Contract or otherwise created, assembled, maintained, or held by the Contractor, including that information marked as confidential or proprietary and determined by the Attorney General or a court of competent jurisdiction to be subject to disclosure under the Act. This section will survive the termination of this Contract.

16.28 Notices. All notices, consents, approvals, demands, requests, or other communications relied on by the parties will be in writing. Unless this Contract provides otherwise, written notice will be deemed to have been given when delivered in person to the designated representative of the Contractor or Owner or transmitted by fax machine to the last known business fax number of the designated representative. Mail notices are deemed effective upon receipt or on the third business day after the date of mailing, whichever is sooner. Fax notices are deemed effective the next business day after faxing.

16.28.1 The address of Owner for all purposes under this Contract will be:

President and CEO
Travis County Healthcare District d/b/a Central Health
1111 East Cesar Chavez Street
Austin, Texas 78702

16.28.2 The address of the Contractor for all purposes under this Contract will be as defined and listed on the Contract signature page.

16.28.3 The parties may make reasonable changes in the person or place designated for receipt of notices upon advance written notice to the other party.

BY SIGNING BELOW, the Parties have executed and bound themselves to this Agreement as of the day and year first above written.

FOR CONTRACTOR:	FOR CENTRAL HEALTH:
Name: _____	Name: _____
Title: _____	Title: _____
Date: _____	Date: _____
Contact for Notice Purposes:	

Attachment A

Not Used

Attachment B – Contractor’s Project Schedule
(to be attached)

Attachment C – Contractor’s Schedule of Values
(to be attached)

Attachment D - Insurance

1. Insurance Schedules

1.1. The Contractor shall not commence Work under the Construction Contract until he has obtained all the insurance required hereunder and certificates of such insurance have been filed with and reviewed by the Owner. Acceptance of the insurance certificates by the Owner shall not relieve or decrease the liability of the Contractor. Owner shall be named as an additional insured on the policies. Contractor shall not change or modify the insurance coverage without prior notice to the Owner.

1.2. Unless otherwise provided for in the Contract Documents, the Contractor shall provide and maintain, until the Work covered in the Construction Contract is completed and accepted by the Owner, the minimum insurance coverages in the following schedule.

1.3. The minimum required limits may be achieved by purchasing an excess liability policy so long as such policy provides coverages at least as broad as the primary insurance.

1.3.1. Worker's Compensation and Employer's Liability Insurance

1.3.1.1. Worker's Compensation Insurance shall be as required by law and shall include an "all states" or "universal" endorsement.

1.3.1.2. Employer's Liability Insurance shall be written for not less than \$500,000 per occurrence.

1.3.1.3. Policy shall also include the following endorsements in favor of County:

1.3.1.4. Waiver of Subrogation (Form TE2046A)

1.3.1.5. Thirty (30) day Notice of Cancellation (Form TE0202A)

1.3.2. Commercial General

1.3.2.1. Minimum Limits:

1.3.2.2. Per Occurrence \$2,000,000

1.3.2.3. Aggregate \$2,000,000

1.4. The following coverages must be specifically insured and certified with no internal sub-limits. A separate aggregate limit is acceptable for the Products/Completed Operations hazard:

1.4.1. Independent Contractors Contingent Liability

1.4.2. Products/Completed Operations Liability

1.4.3. Contractual Liability

1.4.4. "X, C, U" Hazard Liability (if applicable)

1.4.5. Personal Injury Liability including claims related to employment

1.4.6. Broad Form Property Damage Liability, or deletion of the "Care, Custody, and Control" exclusion

1.4.7. Owned, Hired and Non-Owned Automobile Liability

1.4.8. Waiver of Defense of Municipal Liability Immunity

1.5. Policy shall also include the following endorsements in favor of County:

1.5.1. Waiver of Transfer of Recovery against others in favor of Owner

1.5.2. Thirty (30) day Notice of Cancellation (Form TE0202A)

1.5.3. County named as additional insured (Form TE9901B)

1.5.3.1.1. Builders Risk Insurance

1.5.3.1.1.1. Completed value form in an amount equal to the initial contract amount plus Architect fees on a replacement cost basis.

1.5.3.1.1.1.2. The policy shall name as insured the Owner, the Contractor, and all subcontractors on an equal basis.

1.5.3.1.1.1.3. The policy shall be written on an "All Risk" form, to include at least the perils of Fire, Lightning and extended coverage theft, vandalism, malicious mischief, and collapse. Coverage shall continue until acceptance of the Work.

- 1.6. This furnishing of evidence of the required insurance coverages, is one of the Contractor's initial requirements of the Construction Contract that must be performed before a Notice to Proceed can be issued, and if not provided within 15 calendar days after receipt of the Notice of Award, may result in forfeiture of the Contractor's Bid Security. All insurance policies shall be open to inspection by the Owner, and copies of policies shall be submitted to the Owner upon written request. The Contractor is responsible for the payment of all premiums and deductibles.
- 1.7. The contractual liability is to be written on a blanket basis for all written or oral contracts, or specifically endorsed to acknowledge the contractual relationship between the insured and the Travis County Healthcare District. The insurance companies providing coverage must have at least an A.M. Best rating of B+VII and will be subject to the Owner's approval.
- 1.8. All certificates of insurance shall provide that the insurance company shall give the Travis County Healthcare District d.b.a Central Health an affirmative statement, with no qualifications, that thirty (30) days prior written notice will be given to Central Health in the event of policy cancellation, non-renewal or material reduction in coverage provided under the policy, including impairment of any aggregate limits less than \$2,000,000. If policies are written on a "claims made" basis, the retroactive date must be coincident with the date of execution of the Construction Contract. The "other insurance" clause is not applicable to Central Health, where Central Health is an additional insured, and it is intended that the policies covering both Central Health and the Contractor be considered primary coverage. If excess coverage is provided to meet the required policy terms, it must follow the form of the primary coverage.
- 1.9. A waiver of subrogation in favor of Travis County Healthcare District will be endorsed to all policies. Travis County Healthcare District will be named as an additional insured where the Healthcare District's interest may appear.

Attachment E – Liquidated Damages

In the event the Contractor fails to achieve Substantial Completion of the work within the Contract Time specified in the contract, as may be extended by change order or excusable delay, the amount per day given in the following schedule will be deducted from the money due or to become due the Contractor, not as a penalty, but as liquidated damages.

From More than	To and Including	Amount of Liquidated Damages per Working Day
\$ 0	\$ 100,000	\$ 200
100,000	500,000	450
500,000	1,000,000	550
1,000,000	2,000,000	700
2,000,000	5,000,000	850
5,000,000	10,000,000	1,300
10,000,000	15,000,000	1,700
over 15,000,000		2,000

Attachment F

Not Used

Attachment G

Not Used

Attachment H – Performance & Payment Bonds

PERFORMANCE BOND

KNOW ALL PERSONS BY THESE PRESENTS:

That we, _____ as Principal, and the other undersigned as Surety, are held and firmly bound to Travis County, Texas in the penal sum of _____ Dollars (\$ _____), lawful money of the United States, well and truly to be paid to Travis County, Texas, and we bind ourselves, our heirs, successors, executors, and administrators, jointly and severally, firmly by this document.

Whereas, the above-bound Principal has entered into the foregoing Contract with Travis County, Texas, attached hereto, and whereas, pursuant to Texas Government Code Chapter 2253, said Principal is required before commencing the work provided for in said Contract to execute a Bond in the amount of said Contract.

CSP 2108-001 General Contractor for Del Valle Health & Wellness Center

The condition of this obligation is such that if the above-bound Principal, his or its heirs, successors, executors, and administrators must well and faithfully do and perform each and every, all and singular, the work in accordance with the Plans, Specifications, and Contract Documents, including warranty in Paragraph 5.17 (Guarantee Against Defective Work), as provided for in said Contract aforesaid, then this obligation will be null and void; otherwise, it is to remain in full force and effect.

Witness our hands this _____ day of _____, year _____

Principal	Surety
By: _____	By: _____
Title: _____	Title: _____
Attest: _____	Attest: _____

Note: If signed by an officer of the Surety Company, there must be on file a certified extract from the by-laws showing that this person has authority to sign such obligation. If signed by an Attorney-in-Fact, the Travis County Purchasing Office must have a copy of the Power of Attorney in its files.

Surety Company Notice of Claim Information:

Name: _____

Mailing Address: _____

Physical Address: _____

Telephone Number: (____) _____

Bond Number: _____

PAYMENT BOND

KNOW ALL PERSONS BY THESE PRESENTS:

That we, _____ as Principal, and the other undersigned as Surety, are held and firmly bound to Travis County, Texas in the penal sum of _____ Dollars (\$ _____), lawful money of the United States, well and truly to be paid to Travis County, Texas, and we bind ourselves, our heirs, successors, executors, and administrators, jointly and severally, firmly by this document.

Whereas, the above bound Principal has entered into a Contract with Travis County, Texas, which is attached to this Payment Bond, and whereas, pursuant to Texas Government Code Chapter 2253, Principal is required before commencing the work provided for in that Contract to execute a Bond in the amount of that Contract solely for the protection of all claimants supplying labor and materials as defined by law, in the prosecution of the work provided for in that contract, for the use of each such claimant.

CSP 2108-001 General Contractor for Del Valle Health & Wellness Center

The condition of this obligation is that if the above bound Principal, his or its heirs, successors, executors, and administrators must well and faithfully make payments to each and every claimant as defined by law, supplying labor and materials as defined by law, in the prosecution of the work provided for in the attached contract, then this obligation will be null and void; otherwise, it is to remain in full force and effect.

Witness our hands this _____ day of _____, year _____

Principle
By: _____
Title: _____
Attest: _____

Surety
By: _____
Title: _____
Attest: _____

Note: If signed by an officer of the Surety Company, there must be on file a certified extract from the by-laws showing that this person has authority to sign such obligation. If signed by an Attorney-in-Fact, the Travis County Purchasing Office must have a copy of the Power of Attorney in its files.

Surety Company Notice of Claim Information:

Name: _____
Mailing Address: _____
Physical Address: _____
Telephone Number: (____) _____
Bond Number: _____

EXHIBIT I
CERTIFICATE OF INTERESTED PARTIES

CERTIFICATE OF INTERESTED PARTIES		FORM 1295	
Complete Nos. 1 - 4 and 6 if there are interested parties. Complete Nos. 1, 2, 3, 5, and 6 if there are no interested parties.		OFFICE USE ONLY	
1 Name of business entity filing form, and the city, state and country of the business entity's place of business.		Must file online at www.ethics.state.tx.us/File	
2 Name of governmental entity or state agency that is a party to the contract for which the form is being filed.			
3 Provide the identification number used by the governmental entity or state agency to track or identify the contract, and provide a description of the services, goods, or other property to be provided under the contract.			
4		Nature of Interest (check applicable)	
Name of Interested Party	City, State, Country (place of business)	Controlling	Intermediary
5 Check only if there is NO Interested Party. <input type="checkbox"/>			
6 UNSWORN DECLARATION My name is _____, and my date of birth is _____. My address is _____ (street) _____ (city) _____ (state) _____ (zip code) _____ (country). I declare under penalty of perjury that the foregoing is true and correct. Executed in _____ County, State of _____, on the _____ day of _____, 20_____. (month) (year)			
_____ Signature of authorized agent of contracting business entity (Declarant)			
ADD ADDITIONAL PAGES AS NECESSARY			

Attachment J

Not Used

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- C1.2 PROPERTY SURVEY
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- C5.1 DETENTION POND
- C5.2 DETENTION POND DETAILS
- C6.0 GENERAL WATER AND WASTEWATER NOTES
- C6.1 WATER AND WASTEWATER PLAN
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- C7.0 STANDARD DETAILS SHEET 1
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- L1.10 HARDSCAPE DETAILS
- L1.11 HARDSCAPE DETAILS
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T5.1 GENERAL DETAILS – COMMUNICATIONS

END OF DRAWING INDEX

SECTION 00 31 32 – GEOTECHNICAL DATA

PART 1 GENERAL

1.01 DESCRIPTION

- A. A Soil Investigation Report has been prepared by Terracon, dated February 21, 2021 Project No. 96205256.
- B. The soil investigation report was obtained only for use by the Architect/Engineer in design and is not a part of the Contract Documents.
- C. A copy of the report is included for information **only**, but the report is not a warranty of sub-surface conditions at Project site.
- D. Contractor shall visit the Project site to become acquainted with actual conditions present and make additional investigations as necessary to ensure successful completion of the work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION



Geotechnical Engineering Report

Southeast Travis County Wellness Center

Austin, Texas

February 24, 2021

Terracon Project No. 96205256

Prepared for:

Central Health

Austin, Texas

Prepared by:

Terracon Consultants, Inc.

Austin, Texas



February 24, 2021

Central Health
1111 E. Cesar Chavez Street
Austin, Texas 78702



Attn: Mr. Steven Lamp
P: (512) 978-8155
E: Steven.Lamp@centralhealth.net

Re: Geotechnical Engineering Report
Southeast Travis County Wellness Center
7050 Elroy Road
Austin, Texas
Terracon Project No. 96205256

Dear Mr. Lamp:

We have completed the Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. P96205256, Revision 1 dated September 21, 2020. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, subgrade preparation, and the design and construction of foundations, pavements, and site improvements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Diego Munar Castaneda, P.E.
Project Geotechnical Engineer

Bryan S. Moulin, P.E.
Senior Principal, Geotechnical Department Manager



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Note: This report was originally delivered in a web-based format. **Orange Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the **GeoReport** logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

SITE LOCATION AND EXPLORATION PLANS

EXPLORATION RESULTS (Boring Logs and Laboratory Data)

SUPPORTING INFORMATION (General Notes, Unified Soil Classification System, and COA MSWL Form)

Note: Refer to each individual Attachment for a listing of contents.

Geotechnical Engineering Report
Southeast Travis County Wellness Center
7050 Elroy Road
Austin, Texas
Terracon Project No. 96205256
February 24, 2021

INTRODUCTION

This report presents the results of our subsurface exploration and geotechnical engineering services performed for the proposed Central Health Facility project to be located at 7050 Elroy Road in Austin, Texas. This project was authorized by Central Health through issuance of Task Order 001 on October 9, 2020 and performed under the terms of a Professional Services Agreement between Terracon and Central Health dated July 27, 2018. This study was performed in general accordance with Terracon Proposal No. P96205256, Revision 1 dated September 21, 2020. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Lateral earth pressures
- Foundation design and construction
- Floor slab design and construction
- Seismic site classification
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of ten (10) test borings designated B-1 through B-6, and P-1 through P-4 to depths ranging from approximately 25 to 10 feet below existing site grades.

Maps showing the site and boring locations are shown in the **Site Location** and **Exploration Plan** sections, respectively. The results of the laboratory testing performed on soil samples obtained from the site during the field exploration are included on the boring logs in the **Exploration Results** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project is located at 7050 Elroy Road in Austin, Texas. See Site Location

Item	Description
Existing Improvements	Undeveloped.
Current Ground Cover	Soils and grass.
Existing Topography	Based on a Topographic Survey dated August 21, 2020, the site slopes from ~EL 500 feet in the southwest downhill to ~EL 493 feet in the east.
Geology	Based on our review of available geologic information and the samples obtained from the test borings, the study area appears to lie within an area characterized by the Taylor Group clay of Upper Cretaceous Age. The Taylor Group generally consists of highly plastic expansive clay soils ranging in color from tan to dark gray.

PROJECT DESCRIPTION

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Information Provided	<ul style="list-style-type: none"> ■ Email, Geotech Scope of Services document, and Topographic Survey provided by Mr. Steven Lamp with Central Health on August 27, 2020. ■ Concept Site Plan provided by Ms. Rachel Toronjo with Central Health on December 14, 2020.
Proposed Structures	Based on the information provided by the Client, we understand that the project includes the construction of the following; <ul style="list-style-type: none"> ■ A single-story Health Facility with a footprint of approximately 18,000 square feet (SF). ■ Associated parking, driveway, and drive-thru areas.
Building Construction	Steel-frame or wood-frame assumed
Finished Floor Elevation	Unknown but anticipated to be ≤ 2 feet from existing grades.
Maximum Loads	Unknown but anticipated to be lightly loaded.
Grading/Slopes	Unknown but assumed to be ≤ 2 feet from existing grades. Slopes assumed to be no steeper than 3H:1V (Horizontal to Vertical).
Below-Grade Structures	None anticipated
Free-Standing Retaining Walls	None anticipated
Pavements	We assume both rigid (concrete) and flexible (asphalt) pavement sections should be considered.

GEOTECHNICAL CHARACTERIZATION

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of site preparation and foundation options. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section and the GeoModel can be found in the **Figures** section of this report.

As part of our analyses, we identified the following model layers/strata within the subsurface profile. For a more detailed view of the model layer/stratum depths at each boring location, refer to the GeoModel.

Model Layer/ Stratum	Layer Name	General Description
1	Surficial Fat Clays	Dark brown to brown to grayish brown, medium stiff to hard, Fat Clay (CH)
2	Deeper Fat Clays	Light brown to orangish brown to tan, very stiff to hard, Fat Clay (CH)

Groundwater

The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was not observed in the borings while drilling, nor for the short duration the borings could remain open. However, this does not necessarily mean no groundwater may be present at the site as groundwater conditions can (and likely will) vary between the time of the geotechnical investigation and the timeframe of construction activities.

Groundwater seepage is possible at this site, particularly in the form of seepage traveling along pervious seams/fissures in the soil and/or along soil stratum interfaces. Due to the low permeability of the soils encountered in the borings, a relatively long period may be necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers sealed from the influence of surface water are often required to define groundwater levels in materials of this type. Please contact us if this is desired. Groundwater conditions should be evaluated immediately prior to construction.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

GEOTECHNICAL OVERVIEW

Based on our test borings, expansive soils (Stratum 1/2 soils) that exhibit a high to very high potential for volumetric change during moisture variations are present at the site near the ground surface. Based on existing grades, the soils at the site exhibit a Potential Vertical Rise (PVR) of up to 6½ inches as estimated by the Texas Department of Transportation (TxDOT) Method TEX-124-E.

This report provides recommendations to help mitigate the effects of soil shrinkage and expansion. However, even if these procedures are followed, some movement and (at least minor) cracking in the structure should be anticipated. The severity of cracking and other damage such as uneven floor slabs will probably increase if modification of the site results in excessive wetting or drying of the expansive soils. Eliminating the risk of movement and distress may not be feasible, but it may be possible to further reduce the risk of movement if significantly more expensive measures are used during construction. We can discuss these additional measures if desired.

The high plasticity fat clay could become problematic with typical earthwork and construction traffic, especially after precipitation events. Effective drainage should be completed early in the construction sequence and maintained after construction to avoid potential issues. Additional site preparation recommendations including subgrade improvement and fill placement are provided in the **Earthwork** section.

The **Shallow Foundations** section addresses the support of the structure on a monolithic slab-on-grade foundation or spread/strip footing foundation bearing into select fill. Alternatively, the **Deep Foundations** section addresses support of the building on drilled piers bearing into Stratum 2 soils. The **Building Subgrade Preparation** section addresses slab support of the structure.

Lateral earth pressures are provided for on-site retaining walls (i.e., double-formed walls) in the **Lateral Earth Pressures** section.

Asphaltic concrete and/or portland cement concrete pavement systems are recommended for this site. The **Pavements** section addresses the design of pavement systems.

Slope inclinations and construction recommendations are provided for cut and fill slopes (embankments). The **Slope Stability** section addresses cut and fill slopes.

The **General Comments** section provides an understanding of the report limitations.

EARTHWORK

Earthwork is anticipated to include clearing and grubbing, excavations, and fill placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the

state considered in our geotechnical engineering evaluation for foundations, floor slabs, and pavements.

Site Preparation

Construction areas should be stripped of all vegetation, loose soils, fill soils, top soils, and other unsuitable material currently present at the site. We recommend that Terracon be retained to assist in evaluating exposed subgrades during earthwork so that unsuitable materials, if any, are removed at the time of construction.

Proof-Rolling

Once initial subgrade elevations have been achieved (i.e., after cuts but prior to fills), the exposed subgrade in all construction areas (except landscaping) should be carefully and thoroughly proof-rolled with a 20-ton pneumatic roller, fully-loaded dump truck, or similar equipment to detect weak zones in the subgrade. Weak areas detected during proof-rolling, zones containing debris or organics, and voids resulting from removal of tree roots, fill, etc. should be removed and replaced with soils exhibiting similar classification, moisture content, and density as the adjacent in-situ soils (or flowable fill). Proper site drainage should be maintained during construction so that ponding of surface runoff does not occur and cause construction delays and/or inhibit site access.

Moisture-Conditioned Subgrade

After proof-rolling, and just prior to placement of fill, the exposed soil subgrade in all construction areas (except landscaping) should be evaluated for moisture and density through field density testing. If the moisture and/or density requirements do not meet the moisture and density requirements below, the subgrade should be scarified to a minimum depth of 6 inches, moisture conditioned and compacted as per the fill compaction requirements.

Temporary Groundwater Control

Although not encountered during our drilling operations, groundwater seepage is likely to be encountered during construction, especially after periods of wet weather. Temporary groundwater control during construction would typically consist of perimeter gravel-packed drains sloping toward common sump areas for groundwater collection and removal. Placement of drain laterals within the excavation could be required to remediate isolated water pockets.

Fill Material Types

Fill required to achieve design grade should be classified as select/structural fill and general fill. Select/structural fill is material used below, or within 5 feet of structures. General fill is material used to achieve grade in paving, non-reinforced earthen slopes, landscape, or other general

areas (non-structural areas). Earthen materials used for select fill and general fill should meet the following material property requirements:

Fill Type ¹	USCS Classification	Acceptable Specifications
Imported Select/Structural Fill ^{2,3}	CL, SC, and/or GC	<ul style="list-style-type: none"> ■ TxDOT Item 247, Type A, Grade 3, OR ■ Percent Retained on No. 4 Sieve \leq 40 percent with $7 \leq PI \leq 20$ and rocks \leq 4 inches in maximum dimensions, OR ■ Crushed concrete (TxDOT Item 247, Type D, Grade 3 or better)
Paving Fill and General Fill ⁴	CH, CL, SC and/or GC	<ul style="list-style-type: none"> ■ On-Site Soils: Rocks \leq 4 inches in maximum dimension ■ Imported Soils: $PI \leq 50$; Rocks \leq 4 inches in maximum dimension

1. Structural and general fill should consist of approved materials free of organic matter and debris. A sample of each material type should be submitted to the Geotechnical Engineer for evaluation prior to use on this site.
2. As an alternative to the Acceptable Specifications above, a low-plasticity granular material which does not meet these specifications may be used only if approved by Terracon.
3. Based on the laboratory testing performed during this exploration, the excavated onsite soils are not suitable for re-use as select fill. We do not recommend these soils be considered for re-use as select fill when planning budgets. Select fill will need to be imported.
4. Excavated on-site soils, if free of organics, debris, and rocks larger than 4 inches may be considered for re-use as fill in pavement, landscape, or other general areas. Please note that the on-site soils exhibit high to very high shrink/swell potential. For economic reasons, expansive soils are often used in pavement and/or flatwork areas. The owner should be aware that the risk exists for future movements of the subgrade soils which may result in movement and/or cracking of pavement and/or flatwork. If paving fill is imported, the PI should not exceed 50.

Fill Compaction Requirements

Recommended compaction and moisture content criteria for engineered fill materials are as follows.

Material Type		Minimum Compaction Requirement (%) ¹	Moisture Content Range (%)	Maximum Loose Lift Thickness (in) ²
Select/Structural Fill		95 ³	-3 to +3	8 inches
Moisture Conditioned Building Subgrade	PI \leq 25	95	-3 to +3	
	PI $>$ 25	92	+2 to +6	

Material Type		Minimum Compaction Requirement (%) ¹	Moisture Content Range (%)	Maximum Loose Lift Thickness (in) ²
Paving Fill, Paving Subgrade and General Fill	PI ≤ 25	95	-3 to +3	
	PI > 25	95	Optimum to +4	
Crushed Limestone Base (beneath pavements)		100 ⁴	-3 to +3	

1. Per the Standard Proctor Test (ASTM D 698).
2. Fill lift thickness must be reduced (typically 4 to 6 inches) if light compaction equipment is used, as is customary within a few feet of retaining walls and utility trenches.
3. **For fills greater than 5 feet in depth, if any, the compaction should be increased to at least 100 percent of the ASTM D 698 maximum dry unit weight.**
4. Per TEX-113-E.

Utility Trench Backfill

Leaking pipes underneath and/or near the foundations will increase the moisture content of the surrounding subgrade soils and will likely result in a PVR greater than discussed for these soils. For low permeability subgrades, utility trenches are a common source of water infiltration and migration. Utility trenches penetrating beneath the building should be effectively sealed to restrict water intrusion and flow through the trenches, which could migrate below the building. We recommend constructing an effective clay or flowable fill “trench plug” that extends at least 2 feet out from the face of the building exterior. The clay fill/flowable fill should be placed to completely surround the utility line and it should fill the utility trench completely in width and height, with the exception of topsoil at the surface. If clay plug is used, it should be fat clay with a minimum PI of 30 and should be compacted to comply with the water content and compaction recommendations for moisture conditioned building subgrade fill as specified in **Fill Compaction Requirements**. If flowable fill is used, it should be in accordance with TxDOT Item 401 or COA Item 402S.

In the event that the proposed structure is to be designed as structurally suspended slab without building pad preparation, utility lines will be placed in backfilled trenches surrounded by highly expansive clays capable of moving cyclically throughout the year as much as 6½ inches. This level of movement can lead to bending, cracking, or separation of utility connections. After surrounding the utility pipe with bedding material, utility trenches should be backfilled with similar soils as the surrounding subsurface (i.e. select fill within the building pad and on-site clays in landscaping and paving areas). In unpaved areas outside of the building, the utility trenches should be capped with a trench cap of fat clays at least 18 inches thick. Joints and connections to the building should be designed by the MEP as flexible connections to tolerate the potential soil movements. If the slab is elevated with a crawl space, the utilities could be hung from the bottom of the slab above the fat clay soils. Hanging utilities will still require flexible connections where they connect into underground portions of the utility.

Grading and Drainage

The performance of the proposed structure will not only be dependent upon the quality of construction, but also upon the stability of the moisture content of the near surface soils. Therefore, we highly recommend that site drainage be developed so that ponding of surface runoff near the structure does not occur. Accumulation of water near the structure may cause significant moisture variations in soils adjacent to the structure, thus increasing the potential for structural distress.

Effective drainage away from the structure must be provided during construction and maintained through the life of the proposed project. Infiltration of water into excavations should be prevented during construction. It is important that foundation soils are not allowed to become wetted. All grades must provide effective drainage away from the structure during and after construction. The most effective way to achieve this would be to provide concrete aprons (i.e., concrete sidewalks/pavements directly abutting the building) around the exterior perimeter of the structure for at least 6 feet (1 foot wider than the select fill overbuild). The concrete should be sloped to provide drainage away from the structure and all joints should be sealed, particularly those directly abutting the structure. In lieu of providing concrete aprons and if sloping unpaved ground is planned around the structure, then the select fill overbuild (recommended 5 feet beyond the building limits) should be excavated to a depth of at least 2 feet below final grades, removed and replaced with a minimum of 2 feet of moisture conditioned and compacted on-site fat clay soils. The fat clay soils should be compacted and moisture conditioned as per the **Fill Compaction Requirements** section of this report. This procedure is recommended to reduce the possibility of surface runoff infiltrating into the more pervious select fill soils and ponding below the proposed building. We would be glad to discuss other measures (e.g. horizontal or vertical barriers) to reduce moisture infiltration in unpaved areas, if desired. Exposed (unpaved) ground should be sloped at a minimum of 5 percent away from the structure for at least 10 feet beyond the perimeter of the structure. Locally, flatter grades may be necessary to transition ADA access requirement for flatwork.

Roof runoff and surface drainage should be collected and discharged away from the structure to prevent wetting of the foundation soils. Roof gutters should be installed and connected to downspouts and pipes directing roof runoff at least 10 feet away from the structure, or discharged on to positively sloped pavements.

Sprinkler mains and spray heads should preferably be located at least 5 feet away from the structure such that they cannot become a potential source of water directly adjacent to the structure. In addition, the owner and/or builder should be made aware that placing large bushes and trees adjacent to the structures may cause significant moisture variations in the soils underlying the structures. In general, tree roots can adversely influence the subsurface soil moisture content to a distance of 1 to 1½ times the mature height of the tree and beyond the tree canopy. Watering of vegetation should be performed in a timely and controlled manner and

prolonged watering should be avoided. Landscaped irrigation adjacent to the foundation units should be minimized or eliminated. Special care should be taken such that underground utilities do not develop leaks with time.

After building construction and landscaping, final grades should be verified to document effective drainage has been achieved. Grades around the structure should also be periodically inspected and adjusted as necessary as part of the structure's maintenance program. Where paving or flatwork abuts the structure, a maintenance program should be established to effectively seal and maintain joints and prevent surface water infiltration. Water permitted to pond next to the structure can result in greater soil movements than those discussed in this report. Estimated movements described in this report are based on effective drainage for the life of the structure and cannot be relied upon if effective drainage is not maintained.

Earthwork Construction Considerations

Excavations, for the proposed structure and utilities, are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of floor slabs. Construction traffic over the completed subgrades should be avoided as much as possible. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Water collecting over, or adjacent to, construction areas should be removed. If the subgrade desiccates, saturates, or is disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted, prior to floor slab construction.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

The earthwork efforts should be documented under the direction of the Geotechnical Engineer. This should include documentation of adequate removal of vegetation and top soil, proof-rolling and mitigation of areas delineated by the proof-roll to require mitigation and density/moisture testing of subgrade and fills. In the event that unanticipated conditions are encountered, the Geotechnical Engineer should be contacted to evaluate the conditions.

Each lift of compacted fill should be tested, evaluated, and reworked as necessary until approved by the Geotechnical Engineer prior to placement of additional lifts. Fill should be tested for density and water content at a frequency of at least one test for every 5,000 square feet per lift of compacted fill in the building areas (with a minimum of 3 tests per lift) and 10,000 square feet per lift in pavement areas. A minimum of one density and water content test should be conducted for every 100 linear feet of compacted utility trench backfill in paving areas.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

SHALLOW FOUNDATIONS

If the site has been prepared in accordance with the requirements noted in **Earthwork** and **Building Subgrade Preparation**, the following design parameters are applicable for shallow foundations.

Design Parameters – Monolithic Slab-On-Grade

A monolithic slab-on-grade foundation system (either conventionally reinforced or post-tensioned) would be appropriate to support the proposed structure provided subgrade preparation as described in **Building Subgrade Preparation** is followed. The slab foundation design parameters presented in the tables below are based on the criteria published by the Building Research Advisory Board (BRAB), the Prestressed Concrete Institute (PCI), and the Wire Reinforcement Institute (WRI), and the Post-Tensioning Institute (PTI) 3rd Edition. These are essentially empirical design methods and the recommended design parameters are based on our understanding of the proposed project, our interpretation of the information and data collected as a part of this study, our area experience, and the criteria published in the BRAB, PCI, and WRI, and PTI design manuals.

Conventional Slab and Beam System Parameters	
Description	Design Parameter
Minimum Embedment of Grade Beams below Final Grade ¹	18 inches
Bearing Stratum	Select Fill
Bearing Pressures (allowable) ²	Net Dead plus Sustained Live Load – 1,700 psf Net Total Load – 2,500 psf
Subgrade Modulus (k) ³	100 pci

Conventional Slab and Beam System Parameters	
Description	Design Parameter
Approximate Potential Vertical Rise (PVR)	About 1-inch ^{4,5}
<ol style="list-style-type: none"> 1. Embedment is to reduce surface water migration below the foundation elements and to develop proper end bearing and is not based on structural considerations. The grade beam width and depth should be properly evaluated by the structural engineer. Grade beams may be thickened and widened at interior column locations to serve as spread footings at these concentrated load areas. 2. Grade beams should bear on compacted select fill. 3. Several design methods use the modulus of subgrade reaction, k, to account for soil properties in design of flat, floor slabs. The modulus of subgrade reaction is a spring constant that depends on the kind of soil, the degree of compaction, and the moisture content. Based on our recommendations provided in Building Subgrade Preparation, the above indicated subgrade modulus can be used for design of a flat, grade-supported floor slab. 4. Differential movements may result from variances in subsurface conditions, loading conditions and construction procedures. We recommend that measures be taken whenever practical to increase the tolerance of the building to post-construction foundation movements. An example of such measures would be to provide frequent control joints for exterior masonry veneers and interior sheetrock walls (particularly near doors and windows) to control cracking across such walls and concentrate movement along the joints. 5. The building subgrade should be properly prepared as described in Building Subgrade Preparation. 	

BRAB/WRI/PCI Parameters			
Description	Design Parameter		
Design Plasticity Index (PI) ¹	BRAB/WRI/PCI	Prepared Subgrade ²	31
Climatic Rating (C _w)	17		
Unconfined Compressive Strength	1.0 tsf		
Soil Support Index (C) for BRAB	Prepared Subgrade ²		0.83
<ol style="list-style-type: none"> 1. The BRAB effective PI is equal to the near surface PI if that PI is greater than all of the PI values in the upper 15 feet. If the near-surface PI is not highest (i.e., after the building pad is prepared), then the effective PI is the weighted average of the upper 15 feet. The WRI/PCI effective PI is always the weighted average of the PI values in the upper 15 feet. 2. The building subgrade should be properly prepared as described in Building Subgrade Preparation. 			

Post Tensioning Institute (PTI) Parameters ¹	
Description	Design Parameter
Depth of Seasonal Moisture Change ²	10 to 15 feet
Plasticity Index ³	Select Fill – 15 Stratum 1 Soils – 51 to 68 Stratum 2 Soils – 44 to 54

Post Tensioning Institute (PTI) Parameters ¹		
Description	Design Parameter	
Percent Finer than 2 Microns ³	Select Fill – 20 (estimated)	
	Stratum 1 Soils – 35 (estimated)	
	Stratum 2 Soils - 30 (estimated)	
Soil Fabric Factor	1.0	
Approximate Thornthwaite Moisture Index	-12	
Estimated Constant Soil Suction	3.5 pF	
Range of Soil Suction	3.0 to 4.5 pF	
Edge Moisture Variation Distance, e_m ^{4,5}	Center Lift	9.0 feet ⁶
	Edge Lift	4.5 feet ⁶
Differential Soil Movement, y_m ⁵	Center Lift	1.0 inches ⁶
	Edge Lift	1.4 inches ⁶

1. Based on our analysis of the field and laboratory data, design parameters were computed using the Addendum to the 2004 Post-Tensioning Institute (PTI) method¹ for slab-on-grade design and the subsequent Errata to the Addendum approved by the PTI Slab-on-Grade Committee on February 7, 2008.
2. The moisture beneath a shallow foundation will change in response to wetting and drying conditions around the foundation perimeter. The moisture condition has a significant effect on slab behavior and is highly variable with time, changing seasonally, with annual climate conditions, drainage patterns, ground cover, and vegetation (trees and shrubs).
3. The plasticity index and the clay mineral percentage are values of the soil that can be estimated by laboratory tests, and, although variable from location to location, remain relatively constant with time.
4. The maximum moisture variation distance is termed the edge moisture variation distance, e_m , and is an important factor governing the design of post-tensioned floor slabs. The e_m is related to percent fine clay and climatic conditions as well as other parameters, such as soil fabric factor and unsaturated diffusion coefficient.
5. The differential movements, y_m , and edge moisture variation distances, e_m , were calculated by modeling soil profiles using the commercial software program VOLFLO as recommended by the PTI manual.
6. Values may be used provided subgrade preparation is implemented as described in **Building Subgrade Preparation**.

Design Parameters – Footings

As an alternative to a monolithic slab-on-grade foundation system, spread/strip footings may be considered. Principal column and wall loads for the proposed structure may also be supported on

¹. Post-Tensioning Institute, "Addendum No. 1 to the 3rd Edition of the Design of Post-Tensioned Slabs-on-Ground", Post-Tensioning Institute, Phoenix, AZ, May 2007.

isolated (spread) and/or continuous (strip) footings. Design parameters for spread/strip footing foundations are provided below.

Description	Design Parameter
Bearing Stratum ¹	Select Fill
Minimum Embedment Below Final Grade ²	24 inches
Minimum Footing Dimensions	Spread – 3 feet by 3 feet square Strip – 18 inches wide
Allowable Bearing Pressures ^{3,4}	Net dead plus sustained live load – 1,700 psf Net allowable total load – 2,500 psf
Approximate Total Movement ⁵	1-inch
Estimated Differential Movement ⁶	½ to ¾ inch
Nominal (unfactored) Passive Resistance ⁷	330 psf per foot of depth
Coefficient of Sliding Resistance ⁸	0.35
Nominal (unfactored) Uplift Resistance ⁹	Foundation Weight (150 pcf) & Soil Weight (120 pcf)

1. Unsuitable or soft soils must be over-excavated and replaced per the recommendations presented in **Earthwork** and the building area should be prepared as per **Building Subgrade Preparation**.
2. To bear within select fill soils.
3. Whichever condition yields a larger bearing area.
4. Values provided are for maximum loads noted in **Project Description**.
5. The estimated post-construction settlement of the shallow footings is assuming proper construction practices are followed.
6. Differential settlements may result from variances in subsurface conditions, loading conditions and construction procedures. The settlement response of the footings will be more dependent upon the quality of construction than upon the response of the subgrade to the foundation loads.
7. Passive resistance should be neglected in the first 12 inches below finished grades. Care should be taken to avoid disturbance of the footing bearing area since loose material could increase settlement and decrease resistance to lateral loading. If the footing is formed during construction, the open space between the footings and the in-situ soils should be backfilled with concrete.
8. Lateral loads transmitted to the footings will be resisted by a combination of soil-concrete friction on the base of the footings and passive pressure on the side of the footings. We recommend that the allowable frictional resistance be limited to 500 psf.
9. The nominal values should be reduced by an appropriate factor of safety to compute allowable values.

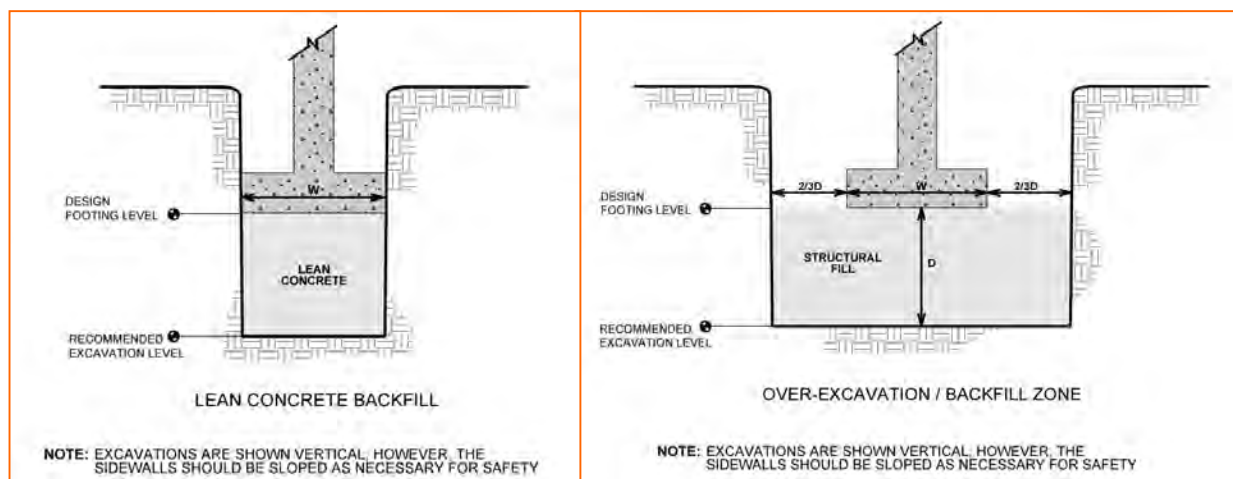
Foundation Construction Considerations

Footings/Grade beams should be neat excavated, if possible. If neat excavation is not possible, the foundation should be properly formed. If a toothed bucket is used, excavation with this bucket

should be stopped approximately 6 inches above final grade of the footings and the footing excavation be completed with a smooth-mouthed bucket or by hand labor. Debris in the bottom of the excavation should be removed prior to steel reinforcement placement. The foundation excavation should be sloped sufficiently to create internal sumps for runoff collection and removal. If surface runoff water or groundwater seepage in excess of ½-inch accumulates at the bottom of the foundation excavation, it should be collected, removed, and not allowed to adversely affect the quality of the bearing surface.

If utilized, the post-tensioned slab-on-grade construction technique should be carefully observed by qualified personnel. The sophistication of this construction procedure requires careful attention to details such as concrete integrity and anchorages, along with tendon spacing, support, covering, and stressing. Poor construction could result in a non-functional slab foundation system.

If unsuitable bearing soils are encountered at the base of the planned footing excavation (such as low strength or disturbed soils), the footing excavations should be deepened to expose suitable bearing materials. The footings could then bear directly on these soils at the lower level, on lean concrete backfill placed in the excavations, or on compacted structural fill backfilled in the excavations and compacted as in **Earthwork**. This is illustrated in the figure below.



Concrete should be placed as soon as possible after excavation to reduce bearing soil disturbance. Soils at bearing level that become disturbed or saturated should be removed prior to placing reinforcing steel and concrete. Adequate water control/dewatering system will aid in minimizing the need for over-excavation and backfill of any soils disturbed by prolonged exposure. It is important that the foundation subgrade not be disturbed by construction activities (e.g., setting forms and placing reinforcing steel). If disturbance occurs, we recommend that the disturbed soils be removed and that the foundation subgrade be protected with the placement of a lean concrete “mud mat”.

Foundation Construction Observation

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. Thus, we recommend that the foundation construction be monitored by Terracon to identify the proper bearing strata and depths and to help evaluate foundation construction. We would be pleased to develop a plan for foundation observation to be incorporated in the overall quality assurance program.

DEEP FOUNDATIONS

Drilled Pier Design Parameters

Soil design parameters are provided below in the **Drilled and Underreamed Pier Design Summary** table for the design of drilled and underreamed pier foundations. The values presented for allowable side friction and end bearing include a factor of safety.

Drilled and Underreamed Pier Design Summary	
Description	Drilled Pier Design Parameters
Bearing Stratum ¹	Stratum 2 soils
Minimum Embedment below FFE	20 feet
Minimum Pier Shaft Diameter	18 inches
End Bearing Pressure (net allowable) ²	Net dead plus sustained live load – 15,000 psf Net total load – 22,000 psf
Side Friction (net allowable) ³	800 psf
Ratio of Underream Diameter to Shaft Diameter ⁴	2:1 to 3:1
Estimated Uplift Force (nominal unfactored) ^{5,6,7}	30*D for prepared subgrade areas 65*D for unprepared subgrade areas
Minimum Percentage of Steel ^{5,6,7}	½ percent
Approximate Total Settlement ^{8,9}	1-inch maximum
Estimated Differential Settlement ^{8,9}	Approximately ½ to ¾ of total maximum

1. To bear within the Stratum 2 soils.
2. Whichever condition yields a larger bearing area.
3. Side friction should be neglected in the upper 10 feet of the pier in contact with soil and lower portion of the pier equal to one underream diameter above the bottom of the pier. Permanently cased pier sections, if any, may not be accounted towards the side friction capacity.
4. In addition to having an adequate bearing area to support compressive loads, the diameter of the underream should be large enough to overcome uplift forces on the pier without causing a local soil failure

to the overlying soils. We recommend that the ratio of an underream diameter to shaft diameter be larger than 2:1 to withstand uplift forces due to soil expansion. However, in no case should this ratio exceed 3:1.

5. The amount of reinforcing steel required can be computed by assuming that the dead load of the structure surcharges the pier, the above estimated force acts vertically on the shaft, and the minimum pier length and embedment is sufficient in withstanding the uplift on the pier itself. The amount of required steel, as calculated by the structural engineer, should extend the entire pier length and in no case should the percentage of steel be less than ½ percent. The equation for uplift force does not include a factor of safety.
6. Uplift force (in kips) is used to calculate pier reinforcing steel. The term “D” is the pier diameter in feet.
7. The recommended minimum embedment depth of the piers below FFE should be sufficient in withstanding soil-related uplift forces. Please note that the uplift force equation given above is intended for calculating the required reinforcing steel and is not intended for calculating pier embedment to overcome soil uplift forces. Additional reinforcing steel may be needed to resist external structural uplift forces.
8. Provided proper construction practices are followed. For adjacent piers, we recommend a minimum edge-to-edge spacing of at least 2 underream diameters (or 3 underream diameters center to center) based on the larger pier diameter of the two adjacent piers. In locations where this minimum spacing criterion cannot be accomplished, Terracon should be contacted to evaluate the locations on a case-by-case basis.
9. Will result from variances in the subsurface conditions, loading conditions and construction procedures, such as cleanliness of the bearing area or flowing water in the shaft.

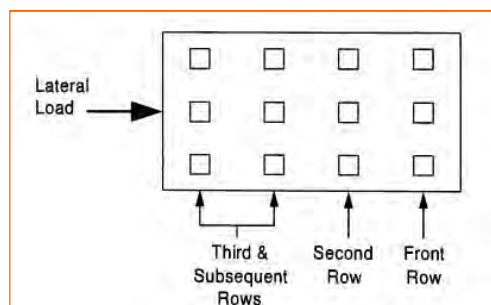
Drilled Pier Lateral Loading

The following table lists input values for use in LPILE analyses. LPILE will estimate values of k_h and E_{50} based on strength; however, non-default values of k_h should be used where provided. Since deflection or a service limit criterion will most likely control lateral capacity design, no safety/resistance factor is included with the following lateral parameters.

Stratum ^{1, 3}	L-Pile Soil Model	S_u (psf) ²	γ (pcf) ²	ϵ_{50} ²
1	Stiff Clay w/o Free Water	1,000	120	0.007
2	Stiff Clay w/o Free Water	3,000	125	0.005

1. See **Subsurface Profile** in **Geotechnical Characterization** for more details on Stratigraphy.
2. Definition of Terms:
 S_u : Undrained shear strength
 γ : Total unit weight
 ϵ_{50} : Non-default E50 strain
3. For modeling lateral resistance, we recommend that the upper 2 feet be ignored due to possible disturbance during construction, installation of utility trenches, installation of landscaping around the perimeter, and to possible changes to the site over time in future additions/expansions.

When piers are used in groups structurally connected together with a large pier cap or mat, the lateral capacities of the piers in the second, third, and subsequent rows of the group should be reduced as compared to the capacity of a single, independent shaft. Guidance for applying p-multiplier factors to the p values in the p-y curves for each row of pier foundations within a pier group are as follows:



- Front row: $P_m = 0.8$;
- Second row: $P_m = 0.4$
- Third and subsequent row: $P_m = 0.3$.

For the case of a single row of piers supporting a laterally loaded grade beam, group action for lateral resistance of piers would need to be considered when spacing is less than three pier diameters (measured center-to-center). However, spacing closer than $3D$ (where D is the diameter of the pier) is not recommended, due to potential for the installation of a new pier disturbing an adjacent installed pier, likely resulting in axial capacity reduction.

The load capacities provided herein are based on the stresses induced in the supporting soil strata. The structural capacity of the piers should be checked to assure they can safely accommodate the combined stresses induced by axial and lateral forces. Lateral deflections of piers should be evaluated using an appropriate analysis method, and will depend upon the pier's diameter, length, configuration, stiffness and "fixed head" or "free head" condition. We can provide additional analyses and estimates of lateral deflections for specific loading conditions upon request. The load-carrying capacity of piers may be increased by increasing the diameter and/or length.

Drilled Pier Construction Considerations

Drilled pier foundations should be augered and constructed in a continuous matter, per the current version of American Concrete Institute's "Standard Specification for the Construction of Drilled Piers" ACI 336. Concrete should be placed in the pier excavations following drilling, and evaluation for proper bearing stratum, embedment, and cleanliness. The piers should not be allowed to remain open overnight before concrete placement. Surface runoff or groundwater seepage accumulating in the excavation should be pumped out and the condition of the bearing surface should be evaluated immediately prior to placing concrete. Drilling equipment with

insufficient torque and/or augers/bits/core barrels that are not suited for variable conditions will likely result in poor production rates.

Although groundwater was not encountered during our field program, zones of groundwater inflow and/or sloughing soils are a possibility during pier construction at this site. Therefore, provisions should be incorporated into the plans and specifications to utilize casing to control sloughing and/or groundwater seepage during pier construction.

The use of casing should help to minimize groundwater inflow into the pier excavation. If soil sloughing or groundwater seepage is encountered at the proposed depth of a pier, it may be necessary to extend the excavation to a depth where the casing can control sloughing and/or seal off groundwater. If seepage persists even after casing installation and casing extension, the water should be pumped out of the excavation immediately prior to placing concrete. If groundwater inflow is too severe to be controlled by pumping, the concrete should be tremied to the full depth of the excavation to effectively displace the water. In this case, a “clean-out” bucket should be used to remove loose soil and/or rock fragments from the pier bottom before placing steel and concrete.

Concrete should exhibit slump as designated in Structural Engineer’s specifications. A design concrete slump of 6 to 8 inches helps to facilitate removal of casings and reduces the possibility of concrete arching/honeycombing. Under no circumstance should loose soil be placed in the space between the casing and the pier sidewalls. The concrete should be placed using a rigid tremie or by the free-fall method provided the concrete falls to its final position through air without striking the sides of the hole, the reinforcing steel cage, or any other obstruction. A drop chute should be used for this free-fall method.

While withdrawing casing, care should be exercised to maintain concrete inside the casing at a sufficient level to resist earth and hydrostatic pressures acting on the casing exterior. Arching of the concrete, loss of seal, mixing of the surrounding soil and water with fresh concrete, and other problems can occur during casing removal and result in contamination of the drilled shaft. These conditions should be considered during the design and construction phases. Placement of loose soil backfill should not be permitted around the casing prior to removal.

The drilled shaft installation process should be monitored under the direction of the Geotechnical Engineer. The Geotechnical Engineer should document the shaft installation process including soil and groundwater conditions encountered, consistency with expected conditions, and details of the installed shaft.

Grade Beams between Drilled Piers

Grade beams spanning between drilled piers may be cast at-grade provided the subgrade in the beam areas is prepared as outlined in **Building Subgrade Preparation**. Grade beams should be

designed to span across the drilled pier foundations without subgrade support, due to stress/strain incompatibility between different bearing materials at varying depths.

In the event that the proposed building is to be designed as structurally suspended slabs without building pad preparation, grade beams spanning between drilled piers should be protected from the expansive soil movement at this site. A minimum 12-inch void provided below the grade beams should allow the expansive clays to swell without causing distress in the grade beams. The sides of the void should be protected with permanent rigid soil retainers so that the soil will not slough beneath the grade beams and thus fill the void. The above also applies to any individual isolated piers, if any, outside of the building footprint. If these isolated piers are overlain by larger pier caps or grade beams, then those caps/beams should also be protected from the clays by using void forms.

We recommend that on-site fat clay soils ($LL \geq 50$; $PI > 30$) be utilized for backfill adjacent to grade beams/panels at the exterior surface of the structure (to reduce potential infiltration of surface water into the subgrade areas). The exterior backfill should be compacted as outlined in **Earthwork**. On the interior sides of the perimeter grade beams/panels, backfill should consist of properly compacted select fill or flowable fill (COA Item 402 or TxDOT Item 401), not sand or gravel. Compaction of select fill on the interior sides of beams or panels (i.e., the pour strips) should be performed by the Earthwork Contractor's personnel and equipment, not by concrete or utility contractors inexperienced with proper soil placements and compaction.

Foundation Construction Observation

The performance of the foundation system for the proposed structure will be highly dependent upon the quality of construction. Thus, we recommend that the foundation installation be monitored by Terracon to identify the proper bearing strata and depths and to help evaluate foundation construction. We would be pleased to develop a plan for foundation monitoring to be incorporated in the overall quality assurance program.

SEISMIC CONSIDERATIONS

The seismic design requirements for buildings and other structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**. Subsurface explorations at this site were extended to a maximum depth of 25 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic

conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

BUILDING SUBGRADE PREPARATION

The subgrade soils are comprised of high to very high plasticity clays exhibiting the potential to shrink/swell with changes in water content. However, construction of the floor slab and revising site drainage creates the potential for gradual increased water contents within the clays. Increases in water content will cause the clays to swell and potentially damage the floor slab.

Due to the potential for significant moisture fluctuations of subgrade material beneath the select fill pad, the exposed final subgrade should be prepared as discussed in the first three sub-sections of **Earthwork**.

The most positive way to minimize the potential for foundation distress resulting from volumetric changes would be to suspend the building above the subgrade on drilled pier foundations with a crawl space or void boxes under the slab and beams. An alternative to this foundation type would be to prepare the subgrade to reduce the shrink/swell potential of the near-surface soils and use grade-supported floor slabs as mentioned below. Although subgrade preparation does help to reduce the shrink/swell potential of the subgrade, a degree of risk of subgrade movements (and corresponding foundation distress) remains if grade-supported floor slabs are to be utilized.

The following sections provide options for floor slab systems and the subgrade preparation for each system. One option is to use a structurally suspended floor slab system, which would not require any extensive subgrade preparation. The other option is a grade-supported floor slab system which would require extensive subgrade preparation.

The post-construction performance of the foundation will likely be influenced more by post-construction volumetric changes of the subgrade due to in-situ moisture variations than upon settlement due to foundation loads. Settlement response of select fill supported slabs will be influenced as much by the quality of construction and fill placements as by soil-structure interaction. Therefore, it is essential that the recommendations for foundation construction be strictly followed during the construction phases of the building pad and foundation.

Structurally Suspended Floor Slab System

For a structurally suspended floor slab system, we recommend a minimum 12-inch void space be provided beneath the floor slabs and the drilled pier foundation system be designed to carry the additional loads. When void forms are used, special care needs to be taken to avoid potential collapse during concrete placement.

The use of a structurally suspended floor slab in conjunction with drilled piers would eliminate the need for subgrade preparation as discussed in the following section. However, a higher uplift force would need to be considered for the drilled pier foundation system as mentioned in **Deep Foundations**.

Due to the absence of subgrade preparation, the native subgrade and/or general fill soils below the floor slab will be subject to drying and wetting during construction. This could lead to additional shrink/swell and possibly even construction access difficulties. To reduce this potential, we recommend either a thin (3 to 4 inches) non-reinforced mud slab or 6 to 8 inches of crushed limestone base material be installed as soon as possible over the exposed Stratum 1 soils and/or general fill once finished grades below the floor slab are established. If crushed limestone base is used the material will provide a better working surface for construction workers, equipment, and traffic, especially during and after periods of wet weather, but it is not intended to function as a capillary break or moisture barrier for the slab.

If the subgrade elevation beneath the floor slab is lower than that of the exterior ground surface in any areas, we recommend that a series of surface drains be placed such that water accumulating in the void space beneath the slab and the subgrade can be properly collected and removed. Sloping the subgrade toward these drains in a manner where water cannot accumulate adjacent to any of the foundation units is recommended. The above can also be accomplished by sloping the subgrade beneath and outside the building to provide positive drainage away from foundation units. In addition, proper ventilation should be provided to reduce the possibility that a high humidity environment could develop in the void space areas.

Any utilities that penetrate into the building subgrade should exhibit flexible connections such that any shrink/swell movements observed in the clays do not damage the utilities. Failure to implement flexible connections can cause damage to the utilities (i.e. bursting pipes). In addition, we recommend that in areas where utilities cross any grade beams, the top of the pipe be at least 6 inches below any void spaces beneath the grade beams.

Grade-Supported Floor Slab System

While the grade-supported floor slab option is not as effective as a structurally suspended floor slab in reducing slab movements, it does represent a compromise between economics and risk of slab distress. If a grade-supported floor slab is utilized, we recommend that the soils immediately below the lowest-level slab be prepared as stated below to reduce the potential for foundation movements associated with volumetric changes of the underlying clay soils due to moisture variation. If drilled piers are the foundation system used, grade beams should continue to be designed as mentioned in **Deep Foundations**.

A select fill pad combined with a moisture conditioned clay subgrade may be implemented in order to reduce post-construction shrink/swell movements to approximately 1-inch. The table below

provides options for various preparation options depending on the amount of select fill desired below the bottom of the floor slab.

Preparation Option	Select Fill Thickness, feet	Moisture Conditioned Clay Thickness (below select fill), feet	Total Building Pad Thickness, feet
1	9	0.5	9.5
2	8	2	10
3	7	4	11

1. As an example, if option 3 is selected, we recommend that the on-site clay soils be removed to a depth of 11 feet below the bottom of the floor slab. At least 4 feet of the excavated soils should be moisture conditioned as outlined in **Earthwork**. The moisture conditioned clay soils should not be allowed to dry out prior to subsequent lift placements. For option 3, select fill should be placed as outlined in **Earthwork** in order to provide a select fill pad of 7 feet below the floor slab.

The exposed building subgrade should be proof-rolled as discussed in **Earthwork**, prior to placement of the moisture conditioned subgrade. The above subgrade preparation recommendations should be applied to an area extending a minimum of 5 feet outside of building areas including attached walkways and any other architectural members. We suggest the use of crushed limestone base in the upper 6 inches of the select fill pad from a standpoint of construction access during wet weather, as well as from a standpoint of floor slab support.

For any flatwork (sidewalk, ramps, etc.) outside of the building area which will be sensitive to movement, subgrade preparation as discussed above should be considered to reduce differential movements between the flatwork and the adjacent building. If subgrade preparation as given above for building areas is not implemented in the exterior flatwork areas, those areas may be susceptible to post-construction movements in excess of that given above.

The potential movement values indicated are based upon moisture variations in the subgrade due to circumstances such as moisture increases due to rainfall and loss of evapotranspiration. In circumstances where significant water infiltration beneath the floor slab occurs (such as a leaking utility line or water seepage from outside the buildings resulting from poor drainage), movements in isolated floor slab areas could potentially be in excess of those indicated in this report.

Where floor slabs are tied to perimeter walls or turn-down slabs to meet structural or other construction objectives, our experience indicates differential movement between the walls and slabs will likely be observed in adjacent slab expansion joints or floor slab cracks beyond the length of the structural dowels. The Structural Engineer should account for potential differential settlement through use of sufficient control joints, appropriate reinforcing or other means. Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual.

Although the indicated preparation options are anticipated to reduce cracking in the floor slab, differential movements at entryways may cause difficulty in opening and closing doors. If the floor

slab is doweled into the perimeter grade beams to control movement, the resulting soil pressures may cause cracks to develop inside of the dowel bars, adjacent to the exterior walls. However, if the floor is not doweled at these locations, a “trip hazard” could result due to the resulting differential movements at entry ways, and difficulty in opening and closing doors could develop.

The use of a vapor retarder should be considered beneath concrete slabs on grade covered with wood, tile, carpet, or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

Floor Slab Construction Considerations

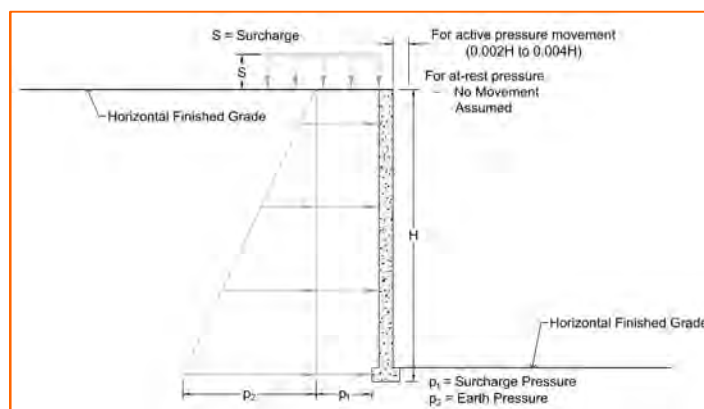
Design recommendations for floor slabs assume the requirements in **Earthwork** have been followed. Specific attention should be given to positive drainage away from the structure and positive drainage of the subgrade and select fill pad beneath the floor slab.

Finished subgrade within and for at least 10 feet beyond the floor slab should be protected from traffic, rutting, or other disturbance and maintained in a relatively moist condition until floor slabs are constructed. If the subgrade should become damaged or desiccated prior to construction of floor slabs, the affected material should be removed and structural fill should be added to replace the resulting excavation. Final conditioning of the finished subgrade should be performed immediately prior to placement of the floor slab support course. Attention should be paid to high traffic areas that were rutted and disturbed earlier, and to areas where backfilled trenches are located.

LATERAL EARTH PRESSURES

Design Parameters

Site retaining walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to values indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and is commonly used for basement walls, loading dock walls, or other walls restrained at the top. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls (unless stated). The recommendations in this section apply to those walls (i.e., double-formed walls) which are installed in open cut or embankment fill areas such that the backfill extends out from the base at an angle of at least 45 degrees from vertical for the entire height and length of the wall.



Lateral Earth Pressure Design Parameters				
Backfill Type	Estimated Total Unit Weight, pcf ¹	Lateral Earth Pressure Coefficients ^{2, 3}		
		At Rest, K _o	Active, K _A	Passive, K _P
Crushed Limestone	135	0.45	0.3	3.5
Clean Sand	120	0.5	0.35	3.0
Clean Gravel	120	0.45	0.3	3.5
Granular Select Fill	130	0.47	0.32	3.2

1. Compaction should be maintained between 95 and 100 percent of Standard Proctor (ASTM D 698) maximum dry density. Overcompaction can produce lateral earth pressure coefficients in excess of those provided.
2. For active earth pressure, wall must rotate about base, with top lateral movements 0.002 H to 0.004 H, where H is wall height. For passive earth pressure, wall must move horizontally to mobilize resistance.
3. Coefficients represent nominal (unfactored) values. Appropriate safety factors should be applied.

The above values do not include a hydrostatic or ground-level surcharge component. To prevent hydrostatic pressure build-up, retaining walls should incorporate functional drainage (via free-draining aggregate or manufactured drainage mats) within the backfill zone. The effect of surcharge loads, where applicable, should be incorporated into wall pressure diagrams by adding a uniform horizontal pressure component equal to the applicable lateral earth pressure coefficient times the surcharge load, applied to the full height of the wall.

All retaining walls should be checked against failure due to overturning, sliding and overall slope stability. Such an analysis can only be performed once the dimensions of the wall and cut/fill scenarios are known. For retaining wall bearing capacity design, we recommend the following parameters.

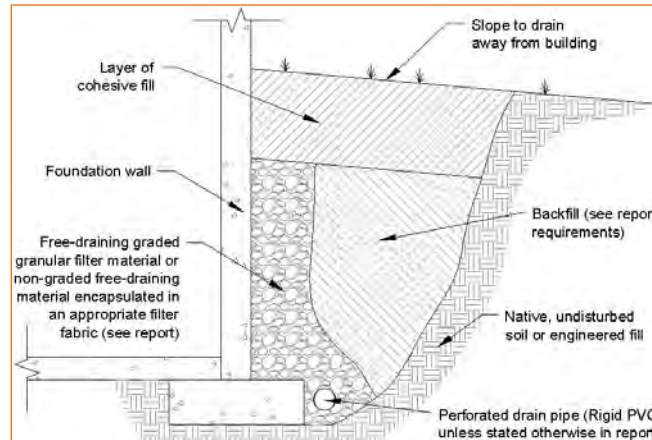
Bearing Material	Coefficient of Sliding Resistance	Maximum Allowable Sliding Resistance, psf	Maximum Allowable Footing Bearing Pressure, psf
On-site Soils ^{1,2}	0.3	300	2,000
Select Fill ³	0.35	500	2,500

1. There exists a higher movement potential for any retaining walls bearing on the on-site soils (up to 6½ inches). If lower movement potential is desired, please contact us so that we may provide additional recommendations.
2. Frequent joints should be provided throughout the length of the retaining wall to reduce cracking due to differential movements caused by the shrink/swell movement of the fat clay subgrade.
3. If the subgrade is prepared as recommended in **Building Subgrade Preparation**, the values for Select Fill may be considered.

We recommend that a “buffer zone” of at least 5 feet wide be applied between pavement areas and retaining walls (with a minimum height of 4 feet or more). This buffer zone should be increased to 10 feet for building areas. These recommended buffer zones are to reduce the potential of distress from any long-term (“creep”) movements of the wall and backfill. Pedestrian sidewalks may be exempted from the above criteria, however some distress could still be observed in the sidewalks due to movements of the retaining walls and backfill.

Subsurface Drainage for Site Retaining Walls

A perforated rigid plastic drain line installed behind the base of walls and extending below adjacent grade is recommended to prevent hydrostatic loading on the walls. The invert of a drain line around an exterior retaining wall should be placed near foundation bearing level. The drain line should be sloped to provide positive gravity drainage to daylight or to a sump pit and pump. The drain line should be surrounded by clean, free-draining granular material having less than 10 percent passing the No. 8 sieve, such as No. 57 aggregate. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade, where it should be capped with compacted cohesive fill to reduce infiltration of surface water into the drain system.



As an alternative to free-draining granular fill, a pre-fabricated drainage structure may be used. A pre-fabricated drainage structure is a plastic drainage core or mesh which is covered with filter fabric to prevent soil intrusion and is fastened to the wall prior to placing backfill.

PAVEMENTS

General Pavement Comments

Pavement designs are provided for the traffic conditions and pavement life conditions as noted in the following sections of this report. A critical aspect of pavement performance is site preparation. Pavement designs, noted in this section, must be applied to the site, which has been prepared as recommended in the **Earthwork** section.

Pavement designs are intended to provide structural sections with adequate thickness over a particular subgrade such that wheel loads are reduced to a level the subgrade can support. Support characteristics of the subgrade for pavement design do not account for shrink/swell movements of an expansive clay subgrade, such as the Stratum 1 soils encountered on this project. Thus, the pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to shrink/swell related movement of the subgrade. It is therefore important to minimize moisture changes in the subgrade to reduce shrink/swell movements. Proper site perimeter drainage should be provided so that infiltration of surface water from unpaved areas surrounding the pavement is minimized.

Lime treatment of the Stratum 1 fat clay subgrade is suggested to enhance the workability and support characteristics of the subgrade as well as to provide a barrier to reduce moisture infiltration in the underlying clay subgrade. The lime treatment also helps to reduce the shrink/swell potential of the lime-treated layer. We should note that if lime treatment is planned, we recommend that the subgrade soils be investigated for the presence of sulfates during construction. Excessive concentrations of sulfates in the soils can result in poor performance of

lime-treated subgrade. Based on numerous research studies performed by education institutions, regulatory agencies, and both public and private entities, soils that contain significant amounts of soluble sulfates are not optimal candidates for lime treatment and may result in excessive heave and subsequent distress to the pavements. Soluble sulfate levels of up to 3,000 ppm or less are generally considered to be acceptable for lime treatment. Soluble sulfate levels between 3,000 ppm and 10,000 ppm in clay soils are generally considered to be moderate to high and pose a greater risk to successful traditional lime treatment. In our prior experience near this site vicinity, the Stratum 1 dark brown to brown clays typically have lower sulfate content levels than the underlying Stratum 2 light brown to tan clays; thus if lime treatment is implemented, we suggest that only the Stratum 1 dark brown to brown clays be used with lime.

Although lime treatment of the subgrade will likely reduce differential movement and heave in the new pavement system, some differential movement will likely occur. Cracking of the concrete pavement due to differential movements should be expected.

Pavement Design Parameters

Design of Asphaltic Concrete (HMAC) pavements are based on the procedures outlined in the 1993 Guideline for Design of Pavement Structures by the American Association of State Highway and Transportation Officials (AASHTO-1993). Design of Portland Cement Concrete (PCC) pavements are based upon American Concrete Institute (ACI) 330R-01; Guide for Design and Construction of Concrete Parking Lots.

Detailed traffic loads and frequencies were not available, however we anticipate that traffic will consist primarily of passenger vehicles in the parking areas and passenger vehicles combined with emergency vehicles, occasional garbage trucks, service and delivery trucks in driveways. If heavier traffic loading is expected or other traffic information is available, Terracon should be provided with the information and allowed to review the pavement sections provided herein. Tabulated below are the assumed traffic frequencies and loads used to design pavement sections for this project.

Pavement Area	Traffic Design Index	Description
Parking Areas (Passenger Vehicles Only)	DI-1	Light traffic – (ESALs ¹ <5) Passenger cars and pickup trucks, no regular use by heavily loaded two axle trucks or lightly loaded larger vehicles.
Driveways	DI-2 ²	Light to medium traffic – (5≤ESALs≤20) Passenger cars and pickup trucks with no more than 50 heavily loaded two-axle trucks or lightly loaded three axle trucks per day. No regular use by heavily loaded trucks with three or more axles.

1. 18-kip equivalent single axle load applications.

2. For Fire Lanes to withstand the occasional HS-20 loading of 32,000 pounds per axle and up to 90,000-pound gross truck weight, use DI-2 pavements or thicker.

Pavement Section Thicknesses

The following tables provides options for HMAC and PCC pavement sections.

Asphaltic Concrete Design				
Layer	Thickness (inches)			
	DI-1		DI-2	
	Option 1A	Option 1B	Option 2A	Option 2B
Asphaltic Concrete (HMAC)	2.0	2.0	2.5	2.5
Crushed Limestone Base	12.0	15.0	13.0	16.0
Lime Treated Subgrade ¹	8.0	-	8.0	-
Moisture Conditioned Subgrade	-	6.0	-	6.0

1. In our prior experience near this site vicinity, the Stratum 1 dark brown to brown clays typically have lower sulfate content levels than the underlying Stratum 2 light brown to tan clays; thus if lime treatment is implemented, we suggest that only the Stratum 1 dark brown to brown clays be used with lime.

Portland Cement Concrete Design		
Layer	Thickness (inches)	
	DI-1	DI-2 ¹
Reinforced Concrete (PCC)	5	6
Moisture Conditioned Subgrade	6	6

1. For the DI-2 traffic loading conditions, the reinforced concrete thickness may be reduced by ½ inch if the clay subgrade is lime treated to a depth of at least 8 inches instead of moisture conditioned
2. We recommend that dumpster pads and loading dock areas be constructed of at least 7-inches of reinforced concrete pavement. The concrete pad areas should be designed so that the vehicle wheels of the collection truck are supported on the concrete while the dumpster is being lifted to support the large wheel loading imposed during waste collection. Dumpster areas that are not designed in this manner often experience localized failures due to large wheel loading imposed during waste collection. Reinforced concrete pavements typically result in better performance and less maintenance than flexible pavement systems in these truck areas.

Rigid PCC pavements will perform better than HMAC pavements in areas where short-radii turning and braking are expected (i.e. entrance/exit aprons) due to better resistance to rutting and shoving. In addition, PCC pavements will perform better in areas subject to large or sustained loads, such as loading docks, dumpster enclosures, and loading/unloading areas.

Areas for parking of heavy vehicles, concentrated turn areas, and start/stop maneuvers could require thicker pavement sections. Edge restraints (i.e. concrete curbs or aggregate shoulders) should be planned along curves and areas of maneuvering vehicles. As an option, thicker sections could be constructed to decrease future maintenance.

Pavement Materials

Presented below are our recommended material requirements for the various pavement sections.

Item	Value
Hot Mix Asphaltic Concrete (HMAC) ¹	Plant mixed, hot laid Type D (Fine-Grade Surface Course) meeting the specifications in TxDOT Item 340 or COA Item 340.
Reinforced Portland Cement Concrete (PCC)	28-day flexural strength (third-point loading) ≥ 500 psi, or 28-day compressive strength ≥ 3,500 psi
Crushed Limestone Base ²	TxDOT Item 247, Type A, Grade 1-2 or COA Item 210 compacted as outlined in Earthwork .
Lime Treated Subgrade ^{3,4}	If soil subgrade consists of high PI (≥30) with ≤ 15% gravel, lime treatment as per TxDOT Item 260 is applicable either through dry placement or slurry placement.
Moisture Conditioned Subgrade ⁵	As outlined in Earthwork .

1. For acceptance and payment evaluation purposes, we recommend the use of the provisions in COA Item 340.
2. Each lift of base should be thoroughly proof-rolled just prior to placement of subsequent lifts and/or asphalt. Particular attention should be paid to areas along curbs, above utility trenches, and adjacent to landscape islands, manholes, and storm drain inlets. Preparation of the base material should extend at least 24 inches behind curbs.
3. We anticipate that approximately 6 to 10 percent hydrated lime will be required to treat the subgrade soils. We suggest 8% lime be used for bidding purposes with add/deduct line items for 1 to 2% lime above or below the base bid items. Prior to the application of lime to the subgrade, the optimum percentage of lime to be added should be determined based on Plasticity Index (TEX-112-E) and/or pH (ASTM D 6276) laboratory tests conducted on mixtures of the subgrade soils with lime. Subgrade soil samples should be obtained from the pavement areas at the proposed final subgrade elevation. Please note that these tests require up to 5 business days to complete.
4. The lime should initially be blended with a mixing device such as a Pulvermixer, sufficient water added, and allowed to cure for at least 48 hours. After curing, mixing should continue until gradation requirements of TxDOT Item 260.4 are achieved. The mixture should then be moisture adjusted and compacted as outlined in Earthwork. Preparation of the lime-treated subgrade should extend at least 24 inches behind curbs, or edge of pavements, whichever is greater.
5. Subgrade should not dry out or become saturated prior to pavement construction. The pavement subgrade should be thoroughly proof-rolled as outlined in **Earthwork**. Particular attention should be paid to areas along curbs, above utility trenches, and adjacent to landscape islands, manholes, and storm drain inlets. Preparation of the moisture conditioned subgrade should extend at least 24 inches behind curbs.

Presented below are our recommendations for the construction of the reinforced concrete pavements.

Item	Value
Reinforcing Steel	#3 bars spaced at 18 inches on center in both directions. Rebar should be placed at midpoint of concrete section and supported on chairs prior to concrete placement.
Control (i.e., Contraction) Joint Spacing	In accordance with ACI 330R, control joints should be spaced no greater than 12.5 feet for 5-inch thick concrete and 15 feet for 6-inch thick or greater concrete. If sawcut, control joints should be cut within 6 to 12 hours of concrete placement. Sawcut joint should be at least ¼ of the slab thickness.
Expansion (i.e., Isolation) Joint Spacing	ACI 330R indicates that regularly spaced expansion joints may be deleted from concrete pavements, except adjacent to structures, manholes, inlets, light poles, etc. Therefore, the installation of expansion joints is optional and should be evaluated by the design/construction team. Expansion joints, if not sealed and maintained can allow infiltration of surface water into the subgrade.
Dowels at Expansion Joints	¾-inch smooth bars, 18 inches in length, with one end treated to slip, spaced at 12 inches on centers at each joint, and placed level at midpoint of concrete section.

Pavement Drainage

On most projects, rough site grading is accomplished relatively early in the construction phase. Fills are placed and compacted in a uniform manner. However, as construction proceeds, excavations are made into these areas, dry weather may desiccate some areas, rainfall and surface water saturates some areas, heavy traffic from concrete and other delivery vehicles disturbs the subgrade, and many surface irregularities are filled in with loose soils to temporarily improve subgrade conditions. As a result, the pavement subgrade should be carefully evaluated as the time for pavement construction approaches. This is particularly important in and around utility trench cuts. All pavement areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to paving. Thorough proof-rolling of pavement areas should be performed no more than 36 hours prior to surface paving. Proof-rolling should be repeated if the site received rainfall prior to paving. Any problematic areas should be reworked and compacted at that time.

Openings in pavements, such as landscaped islands, are sources for water infiltration into surrounding pavement systems. Water can collect in the islands and migrate into the surrounding subgrade soils thereby degrading support of the pavement. This is especially applicable for islands with raised concrete curbs, irrigated foliage, and low permeability near-surface soils. The

civil design for the pavements with these conditions should include features to restrict or to collect and discharge excess water from the islands. Examples of features are self-contained planters, edge drains connected to the storm water collection system, longitudinal subdrains, or other suitable outlet, and impermeable barriers preventing lateral migration of water such as a cutoff wall installed to a depth below the pavement structure.

Pavements should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the pavements could saturate the subgrade and contribute to premature pavement deterioration. In addition, the pavement subgrade should be graded sufficiently to provide positive drainage within the granular base section.

Pavement Maintenance

The pavement sections represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventive maintenance is usually the priority when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur and repairs may be required.

Pavement performance is affected by its surroundings. In addition to providing preventive maintenance, the civil engineer should consider the following recommendations in the design and layout of pavements:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2%.
- Subgrade and pavement surfaces should have a minimum 2% slope to promote proper surface drainage.
- Install perimeter pavement drainage systems (i.e., French drains) surrounding areas anticipated for frequent wetting.
- Install joint sealant and seal cracks immediately.
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils.
- Place compacted, low permeability backfill against the exterior side of curb and gutter.
- Construct curb, gutter and/or sidewalk directly on clay subgrade soils rather than on granular base course materials.

SLOPE STABILITY

Cut Slopes

The table below provides the recommended slope inclinations for both permanent cut slopes and temporary cut slopes. In our opinion, cut slopes at the inclinations discussed below should be stable against a large-scale slide, however the potential for sloughing of loose soils zones exists.

Slope Type	Maximum Slope Inclinations
Temporary	1½(H):1(V) in on-site soils
Permanent	3(H):1(V) in on-site soils ¹

1. For slopes to be used by mowers or other maintenance equipment, slightly flatter 4H:1V slopes are generally preferable.

Exposed cut slopes will also be susceptible to further erosion due to the nature of the on-site soils. Installation of erosion control measures in such areas would be beneficial in reducing the potential slope stability which could result from excessive erosion. In addition to initial erosion control measures, the cut slopes should be periodically checked for erosion (particularly after heavy rainfall events) and maintenance performed on areas exhibiting erosion.

In regards to worker safety, Occupation Safety and Health Administration (OSHA) Safety and Health Standards require the protection of workers adjacent to excavations. The OSHA guidelines and directives should be adhered by the Contractor during construction to provide a safe working environment.

Buffer Zones Adjacent to Cut Slopes

Excavation methods could result in decreased slope stability. To allow for some sloughing to occur, we recommend that a “buffer zone” at least 5 feet wide adjacent to pavement and other general areas be provided between the proposed construction areas and the permanent cut slopes (both at the toe and the crest). If buildings are planned near these areas, the buffer zones should be increased to at least 10 feet. This should help reduce the possibility of sloughing soils/rock from contacting the adjacent improvements on the downhill side and from undermining the improvements on the uphill side.

Embankment Fill Slopes

The table below provides the recommended slope inclinations for embankment fill slopes.

Slope Type	Maximum Slope Inclinations
Embankment Fill Slopes ^{1,2}	3(H):1(V) ³

1. For slopes to be used by mowers or other maintenance equipment, slightly flatter 4H:1V slopes are generally preferable.
2. Fill placement for the embankments should proceed as outlined in **Earthwork**.
3. If steeper permanent slopes in cuts or embankments (natural soils or fill soils) are planned for final grading, then additional services will be required by Terracon to perform detailed slope stability analyses.

The embankment slopes should be properly protected from erosion. The use of rock rip-rap, erosion control fabrics, and/or vegetation is common. In addition to initial erosion control measures, the embankments should be periodically checked for erosion (particularly after heavy rainfall events) and maintenance performed on areas exhibiting erosion.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client, and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there

Geotechnical Engineering Report

Southeast Travis County Wellness Center ■ Austin, Texas

February 24, 2021 ■ Terracon Project No. 96205256



may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

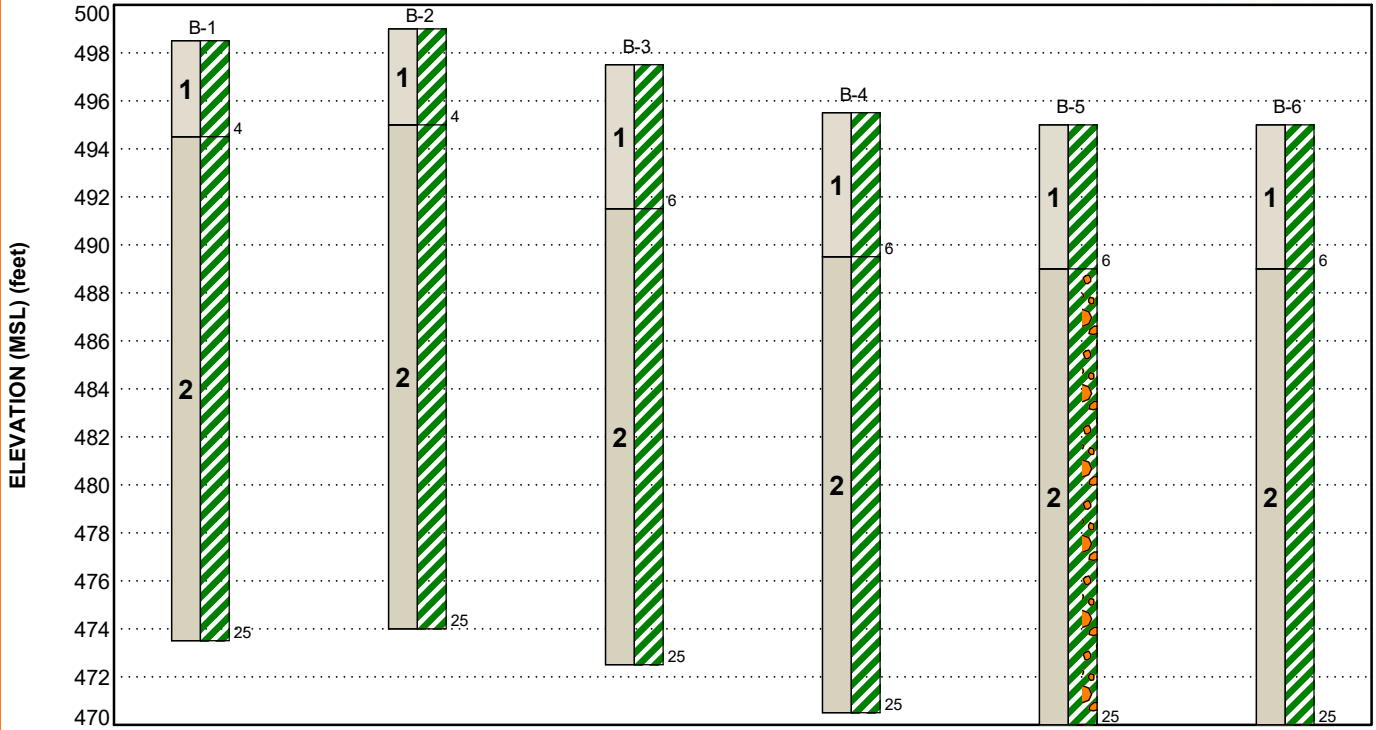
FIGURES

Contents:

GeoModel

GEOMODEL

Southeast Travis County Wellness Center ■ Austin, TX
 Terracon Project No. 96205256



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

Model Layer	Layer Name	General Description
1	Surficial Fat Clays	Dark brown to brown to grayish brown, medium stiff to hard, Fat Clay (CH)
2	Deeper Fat Clays	Light brown to orangish brown to tan, very stiff to hard, Fat Clay (CH)

LEGEND

- Fat Clay
- Fat Clay with Gravel

NOTES:
 Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project. Numbers adjacent to soil column indicate depth below ground surface.

ATTACHMENTS

EXPLORATION AND TESTING PROCEDURES

Field Exploration

Central Health prescribed the following number of boring and depths.

Planned Location	Number of Borings	Planned Boring Depth (feet) ¹
Proposed Building Area	6	25 feet
Proposed Parking/Driveway Area	4	10 feet
TOTAL	10	Maximum Footage of 190 feet

1. Below ground surface.

Boring Layout and Elevations: Unless otherwise noted, Terracon personnel provided the boring layout. Coordinates were obtained with a handheld GPS unit (estimated horizontal accuracy of about ± 10 feet) and approximate elevations were obtained by interpolation from a Topographic Survey dated August 21, 2020. If elevations and a more precise boring layout are desired, we recommend borings be surveyed following completion of fieldwork.

Subsurface Exploration Procedures: We advanced the borings with a truck-mounted rotary drill rig using continuous flight augers (solid stem and/or hollow stem, as necessary, depending on soil conditions). Four to five samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was performed using thin-wall tube (shelby tubes) and/or split-barrel sampling procedures. The split-barrel samplers were driven in accordance with the standard test method for standard penetration test (SPT) and split-barrel sampling of soils (ASTM D1586/D1886M-18). We observed and recorded groundwater levels during drilling and sampling. For safety purposes, all borings were backfilled with auger cuttings after their completion.

The sampling depths, penetration distances, and other sampling information were recorded on the field boring logs. The samples were placed in appropriate containers and taken to our soil laboratory for testing and classification by a Geotechnical Engineer. Our exploration team prepared field boring logs as part of the drilling operations. These field logs included visual classifications of the materials encountered during drilling and our interpretation of the subsurface conditions between samples. Final boring logs were prepared from the field logs. The final boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests to understand the engineering properties of the various soil strata, as necessary, for this project. Procedural

Geotechnical Engineering Report

Southeast Travis County Wellness Center ■ Austin, Texas

February 24, 2021 ■ Terracon Project No. 96205256



standards noted below are for reference to methodology in general. In some cases, variations to methods were applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D2166/D2166M Standard Test Method for Unconfined Compressive Strength of Cohesive Soil
- ASTM D4546 Standard Test Method for One-Dimensional Swell or Collapse of Soils

The laboratory testing program often included examination of soil samples by an engineer. Based on the material's texture and plasticity, we described and classified the soil samples in accordance with the Unified Soil Classification System.

SITE LOCATION AND EXPLORATION PLANS

Contents:

Site Location Plan

Exploration Plan

Note: All attachments are one page unless noted above.

SITE LOCATION

Southeast Travis County Wellness Center ■ Austin, Texas
February 24, 2021 ■ Terracon Project No. 96205256

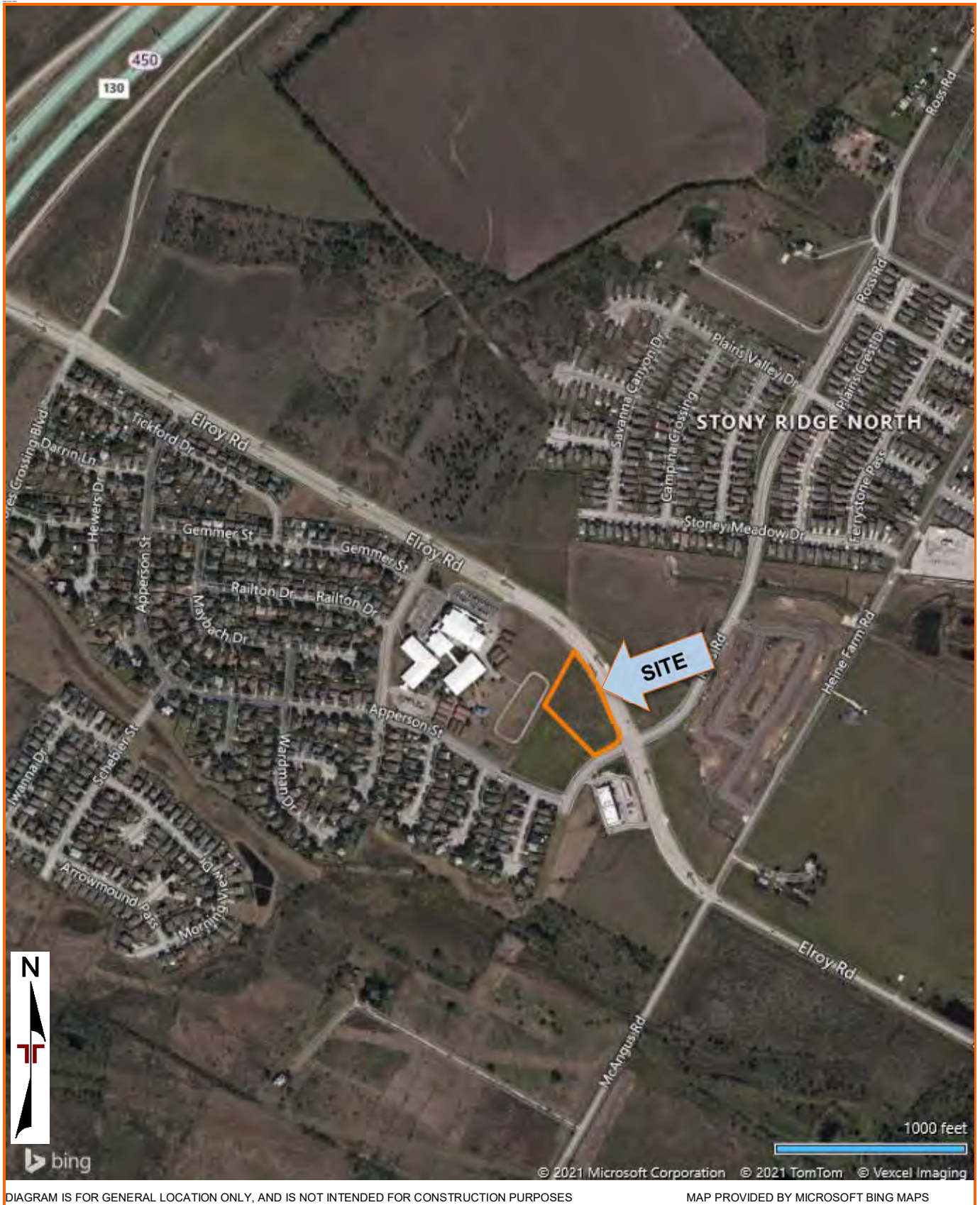


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION PLAN

Southeast Travis County Wellness Center ■ Austin, Texas
February 24, 2021 ■ Terracon Project No. 96205256



DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY CENTRAL HEALTH

EXPLORATION RESULTS

Contents:

Boring Logs (B-1 through B-6, and P-1 through P-4)

Atterberg Limits

Grain Size Distribution (2 pages)

Note: All attachments are one page unless noted above.

BORING LOG NO. B-1

PROJECT: Southeast Travis County Wellness Center

CLIENT: Central Health
Austin, TX

SITE: 7050 Elroy Rd
Austin, TX

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1569° Longitude: -97.6421° Approximate Surface Elev.: 498.5 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH) , trace sand, dark brown to brown, medium stiff to stiff				1.0 tsf (HP)					31.7			
			4.0	494.5+/-		4.5 tsf (HP)	9.81				21.4	102	91-24-67	90
2		FAT CLAY (CH) , light brown to orangish brown, very stiff to hard	5			4.5 tsf (HP)					21.3			
						4.5 tsf (HP)					21.1		74-22-52	97
			10			4.5 tsf (HP)	UC	5.82	4.2	25.8	101			
			15			4.5 tsf (HP)				23.3				
			20			4.5 tsf (HP)	UC	3.35	4.2	29.9	93			
			25			4.5 tsf (HP)								
		Boring Terminated at 25 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 25 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

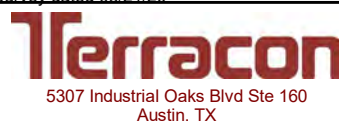
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-21-2021

Boring Completed: 01-21-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_96205256 SOUTH EAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT_2/23/21

BORING LOG NO. B-2

PROJECT: Southeast Travis County Wellness Center

CLIENT: Central Health
Austin, TX

SITE: 7050 Elroy Rd
Austin, TX

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1567° Longitude: -97.6423° Approximate Surface Elev.: 499 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH), trace sand, dark brown, medium stiff to stiff	4.0			1.0 tsf (HP)				34.2		75-24-51	90	
			4.0			4.5 tsf (HP)		29.3						
2		FAT CLAY (CH), light brown to orangish brown, very stiff to hard varies to Lean Clay (CL) at 13 feet	5			4.5 tsf (HP)			22.9		46-19-27			
			5			4.5 tsf (HP)		23.4						
			10			4.5 tsf (HP)	UC	3.96	2.6	24.2			103	
			15			4.5 tsf (HP)			15.0					
			20			4.5 tsf (HP)								
			20			4.5 tsf (HP)	UC	5.36	11.7	23.1			107	
		25.0	474+/-	Boring Terminated at 25 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 25 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

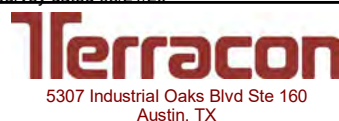
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-20-2021

Boring Completed: 01-20-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

BORING LOG NO. B-3

PROJECT: Southeast Travis County Wellness Center

CLIENT: Central Health
Austin, TX

SITE: 7050 Elroy Rd
Austin, TX

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1567° Longitude: -97.6420° Approximate Surface Elev.: 497.5 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH) , trace sand and gravel, dark brown, very stiff to hard becomes dark brown to brown below 4 feet	5			2.5 tsf (HP)				29.2				
			5			4.5 tsf (HP)				21.0		93-25-68	86	
			6.0	491.5+/-		4.0 tsf (HP)				20.5				
2		FAT CLAY (CH) , trace sand, light brown to orangish brown, hard grades with gravel from 12 to 13 feet becomes light brown to tan, with iron stains below 18 feet	10			4.5 tsf (HP)				20.0	110			
			10			4.5+ tsf (HP)				18.0		72-18-54	96	
			15		X	26-46-38 N=84			18.2					
			20			4.5 tsf (HP)	UC	5.73	4.4	26.8	97			
		25.0	472.5+/-			4.5 tsf (HP)								
		Boring Terminated at 25 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 25 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

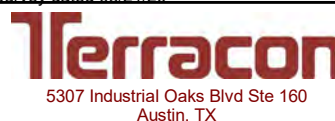
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-21-2021

Boring Completed: 01-21-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL_96205256 SOUTH-EAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT_2/23/21

BORING LOG NO. B-4

PROJECT: Southeast Travis County Wellness Center

**CLIENT: Central Health
Austin, TX**

**SITE: 7050 Elroy Rd
Austin, TX**

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1565° Longitude: -97.6418° Approximate Surface Elev.: 495.5 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH) , trace sand and gravel, dark brown, very stiff becomes dark brown to brown, hard below 2 feet	0			2.0 tsf (HP)				31.6		73-21-52	86	
			2			4.5 tsf (HP)				23.0				
			4			4.5 tsf (HP)				20.4				
			6.0	489.5+/-		4.5 tsf (HP)				18.8		63-19-44	97	
2		FAT CLAY (CH) , trace sand, light brown to orangish brown, hard grades with iron stains below 13 feet becomes light brown to tan below 23 feet	10			4.5 tsf (HP)				19.3				
			15			4.5 tsf (HP)	UC	6.01	9.5	20.4	107			
			20			4.5 tsf (HP)								
			25.0	470.5+/-		4.5 tsf (HP)	UC	6.20	10.2	19.3	113			
		Boring Terminated at 25 Feet	25											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 25 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

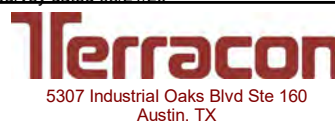
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-21-2021

Boring Completed: 01-21-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

BORING LOG NO. B-5

PROJECT: Southeast Travis County Wellness Center

CLIENT: Central Health
Austin, TX

SITE: 7050 Elroy Rd
Austin, TX

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1564° Longitude: -97.6416° Approximate Surface Elev.: 495 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH) , trace sand, dark brown, stiff becomes brown to grayish brown, hard below 4 feet	5			1.5 tsf (HP)				29.9				
			5			4.5 tsf (HP)			22.6					
			5			4.5 tsf (HP)			20.9		76-19-57	94		
			6.0	489+/-										
2		FAT CLAY WITH GRAVEL (CH) , trace sand, light brown to orangish brown, very stiff to hard grades with iron stains below 13 feet	10			3.5 tsf (HP)				20.3				
			10			4.5 tsf (HP)			17.2		69-20-49	81		
			15			3.0 tsf (HP)	UC	2.93	13.5	20.6	106			
			20			4.5 tsf (HP)	UC	3.13	4.3	29.9	93			
			25	470+/-				4.5 tsf (HP)						
		Boring Terminated at 25 Feet	25											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 25 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

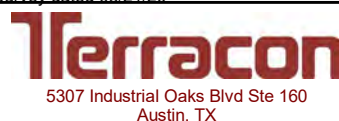
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-21-2021

Boring Completed: 01-21-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

BORING LOG NO. B-6

PROJECT: Southeast Travis County Wellness Center

**CLIENT: Central Health
Austin, TX**

**SITE: 7050 Elroy Rd
Austin, TX**

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1563° Longitude: -97.6418° Approximate Surface Elev.: 495 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH) , trace sand and gravel, dark brown, very stiff to hard				1.5 tsf (HP)					31.4			
						4.0 tsf (HP)					30.3	85-22-63	90	
			5			2.5 tsf (HP)	4.15			24.4	104			
2		FAT CLAY (CH) , trace sand, light brown to orangish brown, hard grades with iron stains below 13 feet	6.0			4.5 tsf (HP)					19.9			
			10			4.5 tsf (HP)					17.8			
			15			4.5 tsf (HP)						17.1	62-17-45	
			20			4.5 tsf (HP)		UC	6.71	13.4	33.0	101		
			25			4.5 tsf (HP)		UC	4.19	14.4	18.8	113		
		Boring Terminated at 25 Feet	25											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 25 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (if any).

Notes:

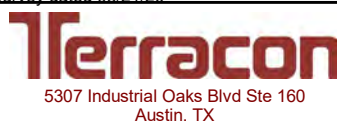
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-21-2021

Boring Completed: 01-21-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

BORING LOG NO. P-1

PROJECT: Southeast Travis County Wellness Center

CLIENT: Central Health
Auston, TX

SITE: 7050 Elroy Rd
Austin, TX

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1572° Longitude: -97.6420° Approximate Surface Elev.: 500 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH) , trace organics, dark brown, very stiff to hard	4.0			1.0 tsf (HP)				31.6		78-23-55		
			4.0	496+/-		4.5 tsf (HP)			20.6					
2		FAT CLAY (CH) , trace sand, light brown to orangish brown, hard, with iron stains	5			4.5 tsf (HP)				21.7				
			5			4.5 tsf (HP)								
			10.0	490+/-		4.5 tsf (HP)								
		Boring Terminated at 10 Feet	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 10 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

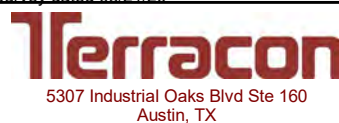
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-20-2021

Boring Completed: 01-20-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

BORING LOG NO. P-2

PROJECT: Southeast Travis County Wellness Center

CLIENT: Central Health
Austin, TX

SITE: 7050 Elroy Rd
Austin, TX

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1567° Longitude: -97.6417° Approximate Surface Elev.: 496.5 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1			5.0			3.5 tsf (HP)								
						4.5 tsf (HP)								
2			5.0			3.5 tsf (HP)								
						3.5 tsf (HP)								
						4.0 tsf (HP)								
Boring Terminated at 10 Feet														

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 10 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

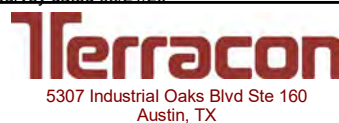
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-20-2021

Boring Completed: 01-20-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

BORING LOG NO. P-3

PROJECT: Southeast Travis County Wellness Center

CLIENT: Central Health
Austin, TX

SITE: 7050 Elroy Rd
Austin, TX

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1564° Longitude: -97.6421° Approximate Surface Elev.: 497 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH) , trace sand, dark brown to brown, stiff	5			1.5 tsf (HP)				29.3		82-23-59		
			5			1.5 tsf (HP)			29.4					
			6.0			4.5 tsf (HP)			19.8					
2		FAT CLAY (CH) , trace sand, light brown to orangish brown, hard	10			4.5 tsf (HP)								
			10.0			4.5 tsf (HP)								
		Boring Terminated at 10 Feet	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 10 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

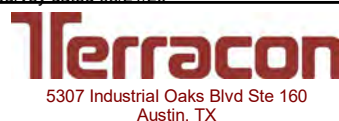
Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-20-2021

Boring Completed: 01-20-2021

Drill Rig: B-59

Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATA TEMPLATE.GDT 2/23/21

BORING LOG NO. P-4

PROJECT: Southeast Travis County Wellness Center

CLIENT: Central Health
Austin, TX

SITE: 7050 Elroy Rd
Austin, TX

MODEL LAYER	GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 30.1561° Longitude: -97.6417° Approximate Surface Elev.: 494 (Ft.) +/- ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SWELL (%)	STRENGTH TEST			WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
								TEST TYPE	COMPRESSIVE STRENGTH (tsf)	STRAIN (%)				
1		FAT CLAY (CH) , trace sand, dark brown to grayish brown, medium stiff to stiff becomes hard below 4 feet	1			1.0 tsf (HP)				28.7		73-19-54		
			2			1.0 tsf (HP)			27.1					
			5			4.5 tsf (HP)		20.2						
2		FAT CLAY (CH) , trace sand, light brown to orangish brown, hard	6.0	488+/-		4.5 tsf (HP)								
			10.0	484+/-		3.0 tsf (HP)								
		Boring Terminated at 10 Feet	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Dry Augered 0 to 10 feet

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

Notes:

Abandonment Method:
Boring backfilled with Auger Cuttings and/or Bentonite

See [Supporting Information](#) for explanation of symbols and abbreviations.

Approximate surface elevation from Topographic Survey dated 08/21/20

WATER LEVEL OBSERVATIONS

No free water observed



Boring Started: 01-21-2021

Boring Completed: 01-21-2021

Drill Rig: B-59

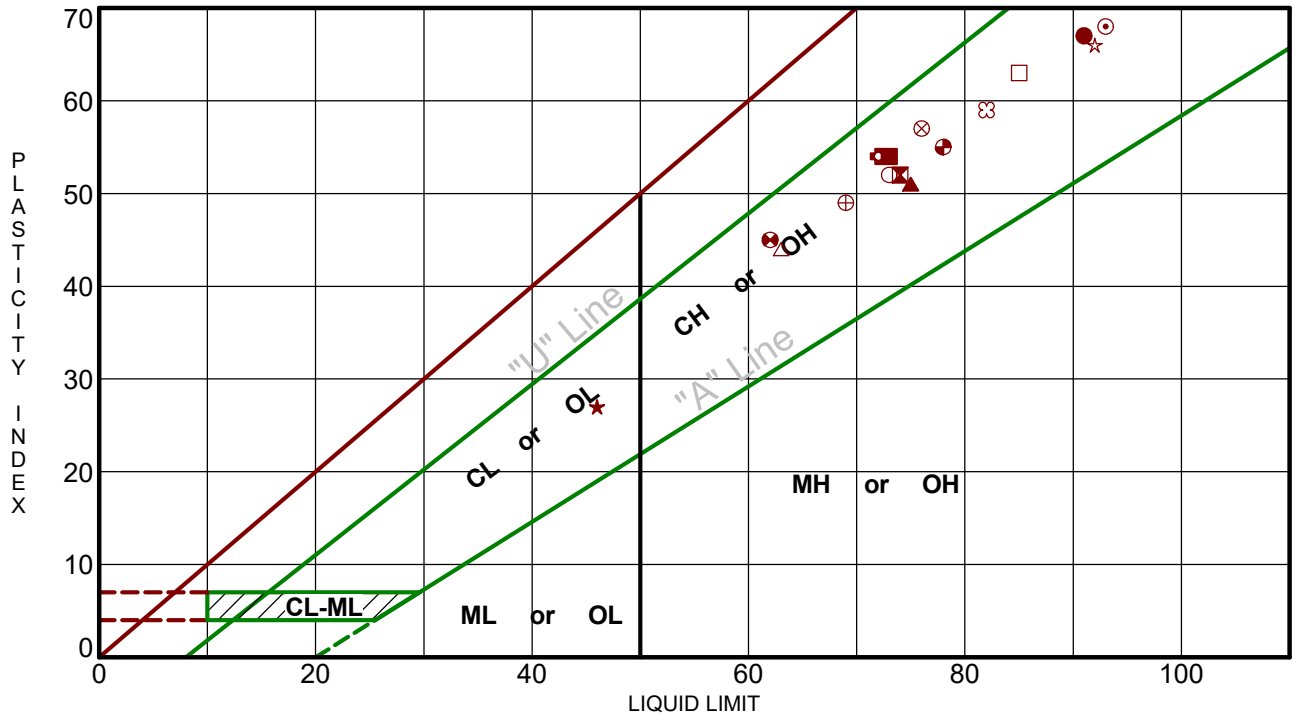
Driller: Core Tech Drilling, Inc.

Project No.: 96205256

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL - 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

ATTERBERG LIMITS RESULTS

ASTM D4318



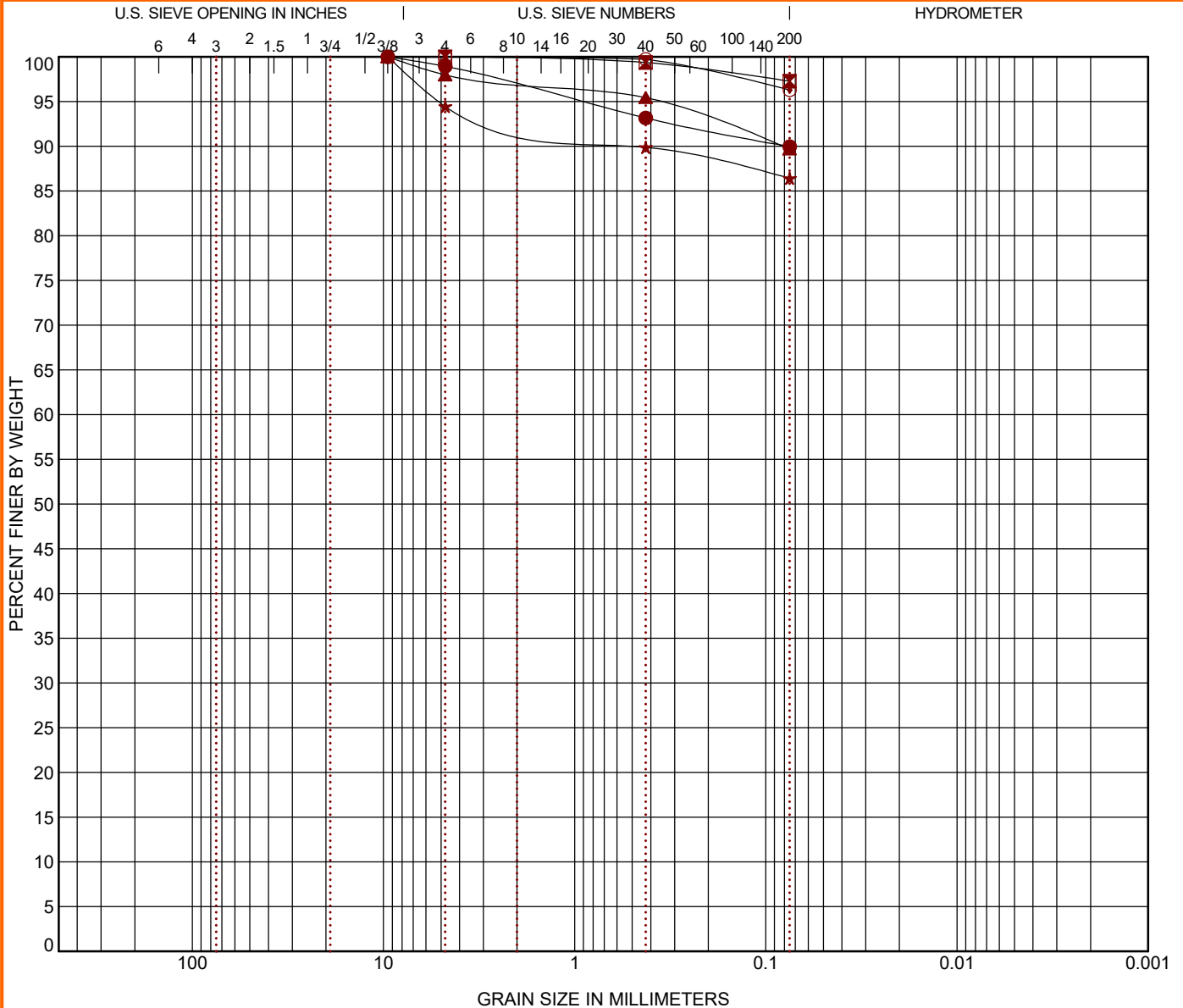
LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. ATTERBERG LIMITS 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
● B-1	2 - 4	91	24	67	90.0	CH	FAT CLAY
⊠ B-1	6 - 8	74	22	52	97.3	CH	FAT CLAY
▲ B-2	0 - 2	75	24	51	89.7	CH	FAT CLAY
★ B-2	13 - 15	46	19	27			
⊙ B-3	2 - 4	93	25	68	86.4	CH	FAT CLAY
⊕ B-3	8 - 10	72	18	54	96.3	CH	FAT CLAY
○ B-4	0 - 2	73	21	52	86.5	CH	FAT CLAY
△ B-4	6 - 8	63	19	44	96.6	CH	FAT CLAY
⊗ B-5	4 - 6	76	19	57	94.2	CH	FAT CLAY
⊕ B-5	8 - 10	69	20	49	80.8	CH	FAT CLAY with GRAVEL
□ B-6	2 - 4	85	22	63	90.1	CH	FAT CLAY
⊕ B-6	13 - 15	62	17	45			
⊕ P-1	0 - 2	78	23	55			
★ P-2	2 - 4	92	26	66			
⊗ P-3	2 - 4	82	23	59			
■ P-4	0 - 2	73	19	54			

PROJECT: Southeast Travis County Wellness Center	 5307 Industrial Oaks Blvd Ste 160 Austin, TX	PROJECT NUMBER: 96205256
SITE: 7050 Elroy Rd Austin, TX		CLIENT: Central Health Auston, TX

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

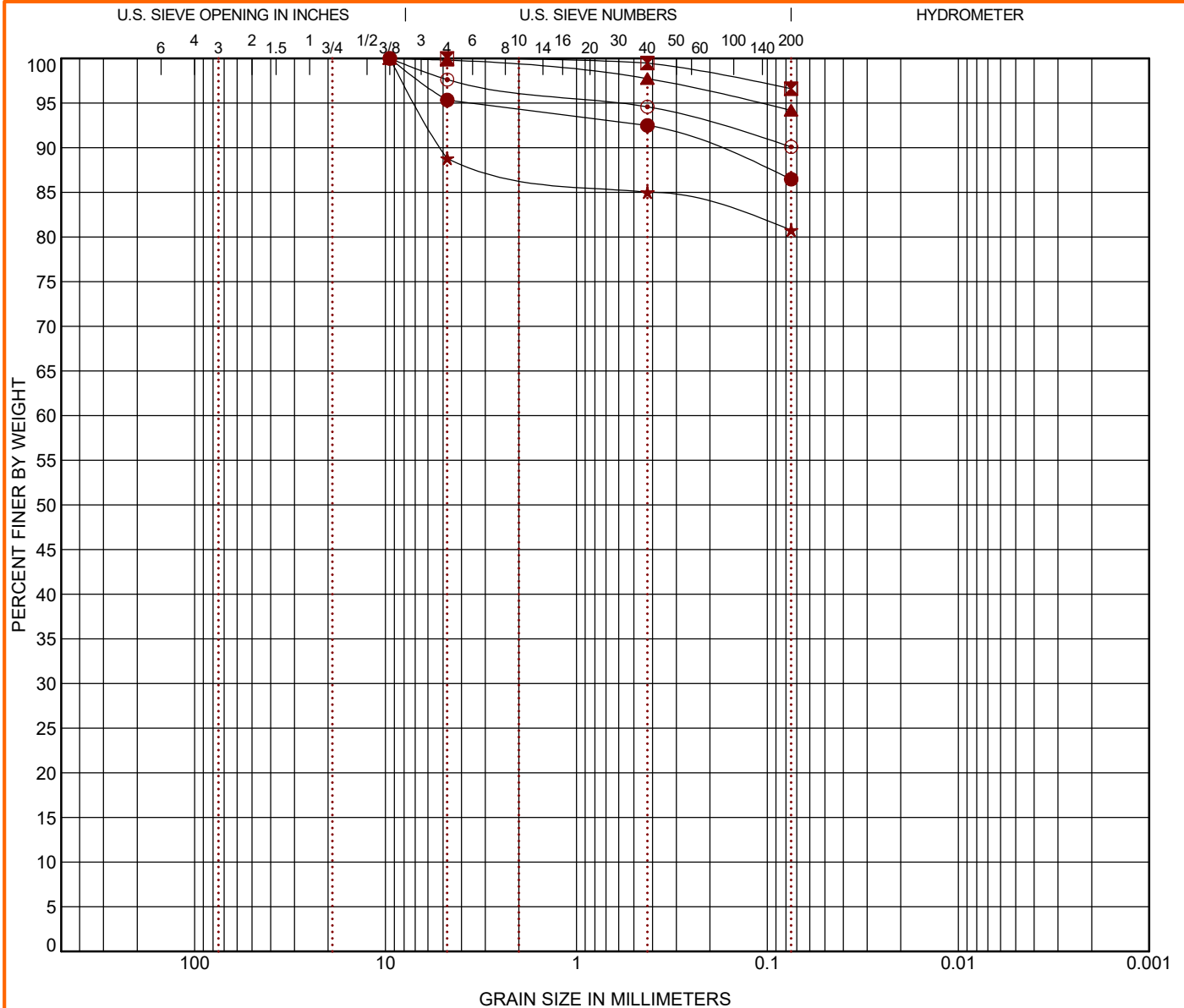
Boring ID	Depth	USCS Classification				WC (%)	LL	PL	PI	Cc	Cu
● B-1	2 - 4	FAT CLAY (CH)				21.4	91	24	67		
☒ B-1	6 - 8	FAT CLAY (CH)				21.1	74	22	52		
▲ B-2	0 - 2	FAT CLAY (CH)				34.2	75	24	51		
★ B-3	2 - 4	FAT CLAY (CH)				21.0	93	25	68		
⊙ B-3	8 - 10	FAT CLAY (CH)				18.0	72	18	54		

Boring ID	Depth	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● B-1	2 - 4	9.5				0.0	1.1	9.0		90.0	
☒ B-1	6 - 8	4.75				0.0	0.0	2.7		97.3	
▲ B-2	0 - 2	9.5				0.0	2.0	8.3		89.7	
★ B-3	2 - 4	9.5				0.0	5.6	8.0		86.4	
⊙ B-3	8 - 10	4.75				0.0	0.0	3.7		96.3	

PROJECT: Southeast Travis County Wellness Center	 5307 Industrial Oaks Blvd Ste 160 Austin, TX	PROJECT NUMBER: 96205256
SITE: 7050 Elroy Rd Austin, TX		CLIENT: Central Health Austin, TX

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Boring ID	Depth	USCS Classification				WC (%)	LL	PL	PI	Cc	Cu
● B-4	0 - 2	FAT CLAY (CH)				31.6	73	21	52		
⊠ B-4	6 - 8	FAT CLAY (CH)				18.8	63	19	44		
▲ B-5	4 - 6	FAT CLAY (CH)				20.9	76	19	57		
★ B-5	8 - 10	FAT CLAY with GRAVEL (CH)				17.2	69	20	49		
⊙ B-6	2 - 4	FAT CLAY (CH)				30.3	85	22	63		

Boring ID	Depth	D ₁₀₀	D ₆₀	D ₃₀	D ₁₀	%Cobbles	%Gravel	%Sand	%Silt	%Fines	%Clay
● B-4	0 - 2	9.5				0.0	4.7	8.9		86.5	
⊠ B-4	6 - 8	4.75				0.0	0.0	3.4		96.6	
▲ B-5	4 - 6	9.5				0.0	0.2	5.6		94.2	
★ B-5	8 - 10	9.5				0.0	11.2	8.0		80.8	
⊙ B-6	2 - 4	9.5				0.0	2.4	7.5		90.1	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 96205256 SOUTHEAST TRAVIS.GPJ TERRACON_DATATEMPLATE.GDT 2/23/21

PROJECT: Southeast Travis County Wellness Center

SITE: 7050 Elroy Rd
Austin, TX



PROJECT NUMBER: 96205256

CLIENT: Central Health
Austin, TX

SUPPORTING INFORMATION

Contents:

General Notes

Unified Soil Classification System

City of Austin (COA) MSWL Form


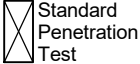




Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Southeast Travis County Wellness Center ■ Austin, TX

Terracon Project No. 96205256

SAMPLING	WATER LEVEL	FIELD TESTS
 Shelby Tube  Standard Penetration Test	 Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See [Exploration and Testing Procedures](#) in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	Standard Penetration or N-Value Blows/Ft.	Descriptive Term (Consistency)	Unconfined Compressive Strength Qu, (tsf)	Standard Penetration or N-Value Blows/Ft.
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A				Soil Classification		
				Group Symbol	Group Name ^B	
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	Gravels: More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels: Less than 5% fines ^C	$Cu \geq 4$ and $1 \leq Cc \leq 3$ ^E	GW	Well-graded gravel ^F	
			$Cu < 4$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	GP	Poorly graded gravel ^F	
		Gravels with Fines: More than 12% fines ^C	Fines classify as ML or MH	GM	Silty gravel ^{F, G, H}	
			Fines classify as CL or CH	GC	Clayey gravel ^{F, G, H}	
	Sands: 50% or more of coarse fraction passes No. 4 sieve	Clean Sands: Less than 5% fines ^D	$Cu \geq 6$ and $1 \leq Cc \leq 3$ ^E	SW	Well-graded sand ^I	
			$Cu < 6$ and/or $[Cc < 1 \text{ or } Cc > 3.0]$ ^E	SP	Poorly graded sand ^I	
		Sands with Fines: More than 12% fines ^D	Fines classify as ML or MH	SM	Silty sand ^{G, H, I}	
			Fines classify as CL or CH	SC	Clayey sand ^{G, H, I}	
Fine-Grained Soils: 50% or more passes the No. 200 sieve	Silts and Clays: Liquid limit less than 50	Inorganic:	$PI > 7$ and plots on or above "A" line	CL	Lean clay ^{K, L, M}	
			$PI < 4$ or plots below "A" line ^J	ML	Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay ^{K, L, M, N}
			Liquid limit - not dried			Organic silt ^{K, L, M, O}
	Silts and Clays: Liquid limit 50 or more	Inorganic:	PI plots on or above "A" line	CH	Fat clay ^{K, L, M}	
			PI plots below "A" line	MH	Elastic Silt ^{K, L, M}	
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay ^{K, L, M, P}
			Liquid limit - not dried			Organic silt ^{K, L, M, Q}
	Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

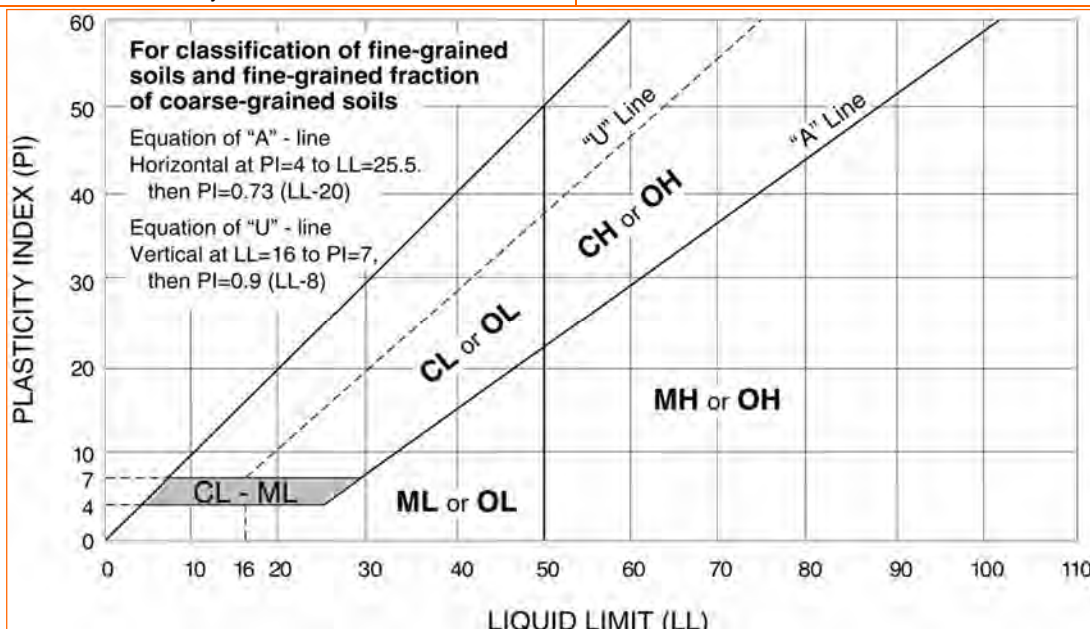
^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N $PI \geq 4$ and plots on or above "A" line.

^O $PI < 4$ or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.





Certification of Compliance with Ch. 25-1-83 – Applications Relating to a Closed Municipal Solid Waste Landfill

Site Address: **7050 Elroy Road**
Austin, Texas

Complete Section A if your site is:

- Less than or equal to 1 acre and **not** within a landfill buffer as shown on the City of Austin Closed Landfills maps.

Complete Section B if your site is:

- Greater than 1 acre; or
- Less than or equal to 1 acre **and** within a landfill buffer as shown on the City of Austin Closed Landfills map.

See back of form for information on where to obtain a map of Austin area closed landfills or how to obtain information about state development regulations.

Section A

The site for which I am submitting an application for subdivision, site plan, or building permit is less than 1 acre, is not within a landfill buffer, and I am not aware of any information indicating the site may contain any portion of a municipal waste landfill.

Signature of Applicant

Print Name

Section B

In our opinion, the subject site does not contain a municipal solid waste landfill as referenced in TAC Ch. 330, Subch. T. This opinion is based on information gathered using:

- TCEQ Soil Test 2
- TCEQ Soil Test 3 --- Based upon geotechnical borings presented in Terracon Report No. 96205256, no evidence of an existing closed municipal solid waste landfill was encountered.

Signature of Professional Engineer

Diego Munar Castaneda, P.E.
Print Name

SECTION 01 10 00 – SUMMARY OF WORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Contract Description.
- B. Owner-Supplied Products.
- C. Contractor's Use of Premises.
- D. Coordination.
- E. Warranty of Construction.

1.02 CONTRACT DESCRIPTION

- A. The project consists of: A new community health and wellness center to include clinic dental and pharmacy.

1.03 OWNER-SUPPLIED PRODUCTS

- A. It shall be the Contractor's responsibility as part of this work to install equipment where indicated on plans and in accordance with the manufacturer requirements making all required connections to building systems to provide a functional installation and working piece of equipment.

1.04 CONTRACTOR'S USE OF PREMISES

- A. Confine operations at site to areas permitted by law, permits, ordinances, and Contract Documents. Coordinate use of premises under direction of the Owner's Representative.
- B. Do not unreasonably encumber site with materials or equipment. Do not load the structure with that will damage or endanger the Work.
- C. Assume full responsibility for protection and safekeeping of products stored on premises. Move any stored products which interfere with operations of Owner. Obtain and pay for use of additional storage or work areas needed for operations.
- D. Refer to sheet E2.1 that shows acceptable contractor lay down area. Provide interior lay down area staging area if available.

1.05 COORDINATION

- A. Coordinate Work of the various specification sections to assure efficient and orderly sequence of installation of construction elements, with provisions for accommodating items to be installed by others, and at a later date.
- B. In the event other contractors are doing work in the same area simultaneously with this project, coordinate proposed construction with that of the other contractors.

- C. Coordinate space requirements and installation of mechanical, plumbing, fire protection, and electrical Work which are indicated diagrammatically on drawings. Follow routing shown for pipes, ducts, and conduits as closely as practicable; make runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. Resolve piping and conduit interference's by giving precedence to pipelines which require a stated grade for proper operation.
- E. In finished areas, conceal pipes, ducts and wiring in the construction. Coordinate locations of fixtures and outlets with finish elements including equipment furnished by Owner.

1.06 WARRANTY OF CONSTRUCTION

- A. For a period of one year from date of substantial completion (or for longer warranty or guarantee periods stipulated elsewhere), warrant that all work conforms to the Contract requirements and is free of any defect of equipment, materials or workmanship. Under the terms of this warranty, remedy at no expense to the Owner, any such failure to conform or any such defect. All movable or adjustable items must remain in proper operating condition throughout the warranty period. Assume responsibility and pay for replacement or repair of adjacent materials or work which may be damaged due to failure of work or repair or replacement of work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 20 00 – PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Schedule of Values
- B. Applications for Payment
- C. Change Procedures
- D. Defect Assessment
- E. Unit Prices

1.02 CHANGE PROCEDURES

- A. Submittals: Submit name of individual authorized to receive change documents, and be responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Owner and Architect/Engineer of any error, inconsistency, omission, or apparent discrepancy.
- C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Owner & Architect/Engineer; establish procedures for handling queries and clarifications.
- D. Advise and include Owner in all RFI, change and similar communications.
- E. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract. All change orders must be approved by Owner.
- F. Correlation of Contractor Submittals:
 - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
 - 2. Promptly enter changes in Project Record Documents.

1.03 DEFECT ASSESSMENT

- A. For Owner and Contractor responsibilities for defective work, refer to Construction Agreement.

1.04 UNIT PRICES

- A. Authority: Measurement methods are delineated in individual specification sections.

- B. Measurement methods delineated in individual specification sections complement criteria of this section. In event of conflict, requirements of individual specification section govern.
 - 1. The Contractor shall take measurements and compute quantities.
- C. Unit Quantities: Quantities and measurements indicated in Bid Form are for contract purposes only. Actual quantities provided shall determine payment.
 - 1. When actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at unit sum/prices contracted.
- D. Payment Includes: Full compensation for required labor, products, tools, equipment, plant and facilities, transportation, services and incidentals; erection, application or installation of item of the Work; overhead and profit unless otherwise noted.
- E. Final payment for Work governed by unit prices will be made on basis of actual measurements and quantities accepted by Architect/Engineer multiplied by unit sum/price for Work incorporated in or made necessary by the Work.
- F. Measurement of Quantities:
 - 1. Weigh Scales: Inspected, tested and certified by applicable state Weights and Measures department within past year.
 - 2. Platform Scales: Of sufficient size and capacity to accommodate conveying vehicle.
 - 3. Metering Devices: Inspected, tested and certified by applicable state department within the past year.
 - 4. Measurement by Weight: Concrete reinforcing steel, rolled or formed steel or other metal shapes will be measured by handbook weights. Welded assemblies will be measured by handbook or scale weight.
 - 5. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.
 - 6. Measurement by Area: Measured by square dimension using mean length and width or radius.
 - 7. Linear Measurement: Measured by linear dimension, at item centerline or mean chord.
 - 8. Stipulated Sum/Price Measurement: Items measured by weight, volume, area or linear means or combination, as appropriate, as completed item or unit of the Work.
- G. Unit Price Schedule:
 - 1. Item 1: Section 31 63 29 – Drilled Piers. Refer to Article 1.03, Unit Prices. For increase in length of piers longer than the base length, the per lineal foot costs shall be as follows

\$ _____ per lineal foot for 18 inch diameter piers.
\$ _____ per lineal foot for 24 inch diameter piers.
\$ _____ per lineal foot for 36 inch diameter piers.

2. Item 2: Section 31 63 29 – Drilled Piers. Refer to Article 1.03, Unit Prices. For decrease in length of piers shorter than the base length, the per lineal foot costs as follows:

\$ _____ per lineal foot for 18 inch diameter piers.
\$ _____ per lineal foot for 24 inch diameter piers.
\$ _____ per lineal foot for 36 inch diameter piers.

The deduct unit price shall not be less than two thirds of the add unit price.

3. Item 3: Section 31 63 29 – Drilled Piers. Refer to Article 1.03, Unit Prices. If casing of piers is required, the cost per lineal foot shall be as follows:

\$ _____ per lineal foot for 18 inch diameter piers.
\$ _____ per lineal foot for 24 inch diameter piers.
\$ _____ per lineal foot for 36 inch diameter piers.

4. Item 4: Section 07 26 13-Moisture Control System: Provide a unit price to furnish and apply a moisture control system as specified. The unit price shall include the cost for preparing the concrete floor in accordance with this section.

\$ _____ per square foot.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 30 00 – ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Preconstruction meeting.
- C. Site mobilization meeting.
- D. Progress meetings.
- E. Preinstallation meetings.
- F. Closeout meeting.
- G. Cutting and patching.
 - 1. Cutting existing concrete pavement for installation of:
 - a. Chain link fence and gates posts.
 - b. Pipe bollards.
 - 2. Cutting holes in existing exterior masonry veneer, EIFS and or metal wall panels sheathing and gypsum wallboard for installation of new piping and conduits.
- H. Special procedures.

1.02 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.
- F. Coordinate with Owner access to site for correction of defective Work and Work not in

accordance with Contract Documents, to minimize disruption of Owner's activities.

1.03 PRECONSTRUCTION MEETING

- A. Contractor will schedule meeting after Notice to Proceed.
- B. Attendance Required: Owner, Engineer and Contractor.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Distribution of Contract Documents.
 - 3. Submission of list of Subcontractors, schedule of values, and progress schedule.
 - 4. Designation of personnel representing parties in Contract and Engineer.
 - 5. Procedures and processing of field decisions, submittals and substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 6. Scheduling.
- D. Contractor shall record minutes and distribute copies within three days after meeting to participants, with one copy to Engineer, Owner and those affected by decisions made. Refer to Contractor Agreement for additional requirements.
- E. Agenda:
 - 1. Use of premises by Owner and Contractor.
 - 2. Security and housekeeping procedures.
 - 3. Schedules.
 - 4. Application for payment procedures.
 - 5. Procedures for testing.
 - 6. Procedures for maintaining record documents.
 - 7. Requirements for start-up of equipment.
 - 8. Inspection and acceptance of equipment put into service during construction period.
- F. Record minutes and distribute copies within four days after meeting to participants, with one copy to Engineer and Owner and those affected by decisions made.

1.04 PROGRESS MEETINGS

- A. Contractor shall schedule and administer meetings throughout progress of the Work at

maximum biweekly intervals.

- B. Make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.
- C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner, Engineer, as appropriate to agenda topics for each meeting.
- D. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems impeding planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of off-site fabrication and delivery schedules.
 - 7. Maintenance of progress schedule.
 - 8. Corrective measures to regain projected schedules.
 - 9. Planned progress during succeeding work period.
 - 10. Coordination of projected progress.
 - 11. Maintenance of quality and work standards.
 - 12. Effect of proposed changes on progress schedule and coordination.
 - 13. Address safety and access/coordination concerns.
 - 14. Other business relating to Work.
- E. Record minutes and distribute copies within four days after meeting to participants, with one copy to Engineer and Owner and those affected by decisions made.

1.05 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific section.
- C. Notify Engineer three days in advance of meeting date unless otherwise noted in the individual specification sections.
- D. Prepare agenda and preside at meeting:

1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.
- E. Record minutes and distribute copies within four days after meeting to participants, with one copy each to Architect/Engineer, Owner and those affected by decisions made.
- F. Notify Owner 48 in advance of any utility and service outages required to perform the work.

1.08 CLOSEOUT MEETING

- A. Contractor to schedule Project closeout meeting with sufficient time to prepare for Substantial Completion. Contractor to preside over meeting and be responsible for meeting minutes.
- B. Attendance required: Contractor, Major Subcontractors, Architect/Engineer, Owner and others appropriate to agenda.
- C. Notify Architect/Engineer and Owner one week in advance of the meeting.
- D. Minimum Agenda:
 1. Start-up facilities and systems.
 2. Operations and maintenance manuals.
 3. Testing, adjusting and balancing.
 4. System demonstration and observation.
 5. Operation and maintenance instructions for Owner's personnel.
 6. Contractor's inspection of Work.
 7. Contractor's preparation of an initial punch list.
 8. Procedure to request Engineer inspection to determine date of Substantial Completion.
 9. Planned progress during succeeding work period.
 10. Coordination of project progress.
 11. Maintenance of quality and work standards.
 12. Effect of proposed changes on Progress Schedule and construction.
 13. Other business relating to Work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 CUTTING AND PATCHING

- A. Employ skilled and experienced installer to perform cutting and patching of the following materials:
 - 1. Existing concrete paving to install fence and gate posts.
 - 2. Existing concrete paving to install pipe bollards.
 - 2. Existing exterior masonry veneer, EIFS and or metal panel in order to install piping.
 - 3. Exterior sheathing and interior gypsum wall board in order to install conduit and piping.
- B. Execute cutting, fitting and patching including excavation to complete Work and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and non-conforming Work.
 - 4. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- C. Execute work by methods to avoid damage to other Work, and to provide proper surfaces to receive patching and finishing.
- D. Cut masonry and concrete materials using masonry saw or core drill.
 - 1. Prior to cutting concrete paving locate and map the following items using a Ferrosan or other approved method to measure the size and depth of the embedded material and to map the position and arrangement of the embedded material:
 - a. Reinforcing steel
 - b. Steel conduit
 - c. Steel embedments
- E. Restore Work with new products in accordance with requirements of Contract Documents.
- F. Fit Work tight to pipes, sleeves, ducts, conduit and other penetrations through surfaces.
- G. Maintain integrity of wall, ceiling or floor construction; completely seal voids.
- H. At penetrations of exterior walls completely seal penetrations as follows:
 - 1. Where piping penetrates existing exterior veneer masonry, EIFS and or metal wall panels seal annular space around pipe with Dowsil 790 sealant and backer rod recommended by sealant manufacturer for material being sealed.
 - a. Other acceptable manufacturer and products:
 - 1) Pecora Corp.- 890 NST
 - 2) Tremco Inc. – Spectrem 1
 - 2. Where piping penetrates existing exterior wall sheathing behind veneer masonry

and or metal wall panels seal annular space with sealant compatible with existing AWB.

- I. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- J. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

3.02 ALTERATION PROCEDURES

- A. Where designated areas of existing facility are to be occupied by Owner during progress of construction, cooperate with Owner in scheduling operations to minimize conflict and to permit Owner's continuous usage.
 - 1. Perform Work not to interfere with operations of occupied areas.
 - 2. Keep utility and service outages to a minimum and perform only after written approval of Owner.
 - 3. Clean Owner-occupied areas daily. Clean spillage, overspray and heavy collection of dust in Owner-occupied areas immediately.
 - a. Notify Owner 48 hours in advance of any utility and service outages required to perform the work.
 - 4. Where existing acoustical ceiling panels are removed to perform above ceiling work, reinstall acoustical ceiling panel at the end of each work day.
- A. Materials: Match existing with new products for patching and extending work.
- B. Employ skilled and experienced installer to perform alteration work.
- C. Cut, move or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion.
- D. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.
- E. Remove debris and abandoned items from area and from concealed spaces.
- F. Prepare surface and remove surface finishes to permit installation of new work and finishes.
- G. Close openings daily in exterior surfaces to protect existing work from weather and extremes of temperature and humidity. Provide means for end of day inspection.
- H. Remove, cut, and patch Work in manner to minimize damage and to permit restoring products and finishes to match existing condition.
- I. Refinish existing visible surfaces to remain in renovated rooms and spaces, to match existing condition for each material, with neat transition to adjacent finishes.

- J. Where new Work abuts or aligns with existing, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- K. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.
- L. Where change of plane of 1/8 inch or more occurs, request instructions from Architect/Engineer.
- M. Patch or replace portions of existing surfaces which are damaged, lifted, discolored or showing other imperfections due to construction activities.
- N. Finish surfaces as specified in individual product sections.

END OF SECTION

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittal procedures.
- B. Construction progress schedules.
- C. Proposed products list.
- D. Product data.
- E. Shop Drawings.
- F. Samples.
- G. Design data.
- H. Test reports.
- I. Certificates.
- J. Manufacturer's instructions.
- K. Manufacturer's field reports.
- L. Construction photographs.
- M. Contractor review.

1.02 SUBMITTAL PROCEDURES

- A. Refer to Construction Agreement.

1.03 CONSTRUCTION PROGRESS SCHEDULES

- A. Refer to Construction Agreement.

1.04 PROPOSED PRODUCTS LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.05 PRODUCT DATA

- A. Product Data: Submit to Architect/Engineer and Owner for review for limited purpose of checking for conformance with information given and design concept expressed in Contract

Documents.

- B. Submit via Newforma.
- C. Mark each copy to identify applicable products, models, options and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. After review, produce copies and distribute in accordance with Submittal Procedures article and for record documents described in Section 01 70 00 – Execution and Closeout Requirements.

1.06 SHOP DRAWINGS

- A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual specification sections, provide Shop Drawings signed and sealed by professional engineer responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit either electronically or in the form of one reproduction.
- E. After review, produce copies and distribute in accordance with Submittal Procedures article and for record documents described in Section 01 70 00 – Execution and Closeout Requirements

1.07 SAMPLES

- A. Samples: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Architect/Engineer for aesthetic, color or finish selection.
 - 2. Submit samples of finishes from full range of manufacturers' standard colors, in custom colors selected, textures, and patterns for Architect/Engineer selection.

3. Include photo image of product sample.
 - C. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - D. Include identification on each sample, with full Project information.
 - E. Submit number of samples specified in individual specification sections; Architect/Engineer will retain one sample.
 - F. Reviewed samples which may be used in the Work are indicated in individual specification sections.
 - G. Samples will not be used for testing purposes unless specifically stated in specification section.
 - H. After review, produce duplicates and distribute in accordance with Submittal Procedures article and for record documents purposes described in Section 01 70 00 – Execution and Closeout Requirements.
- 1.08 DESIGN DATA
- A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.
 - B. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- 1.09 TEST REPORTS
- A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.
 - B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.
- 1.10 CERTIFICATES
- A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.
 - B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits and certifications as appropriate.
 - C. Certificates may be recent or previous test results on material or Product, but must be acceptable to Architect/Engineer.
- 1.11 MANUFACTURER'S INSTRUCTIONS
- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, startup, adjusting and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.
 - B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.12 MANUFACTURER'S FIELD REPORTS

- A. Submit reports for Architect/Engineer's benefit as contract administrator or for Owner.
- B. Submit report in duplicate within 5 days of observation to Architect/Engineer for information.
- C. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.13 CONSTRUCTION PHOTOGRAPHS

- A. Provide digital images of site and construction throughout progress of Work.
- B. Each month submit digital images with Application for Payment.
- C. Digital Images: Label CD or Flash drive with Project Name, contract number, Month taken.
- D. Submit a computer disk with all digital images sorted in chronological sequence.

1.14 CONTRACTOR REVIEW

- A. Contractor to review for compliance with contract Documents and approve submittals before transmitting to Architect/Engineer.
- B. Contractor Responsible for:
 - 1. Determination and verification of materials including manufacturer's catalog numbers.
 - 2. Determination and verification of field measurements and field construction criteria.
 - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
 - 4. Determination and accuracy and completeness of dimensions and quantities.
 - 5. Confirmation and coordination of dimensions and field conditions of Site.
 - 6. Construction means, techniques, sequences and procedures.
 - 7. Safety precautions.
 - 8. Coordination and performance of Work of all trades.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Del Valle Health and Wellness Center
Central Health
Del Valle, Texas
Project No. 2070.00

Submittal Procedures
Section 01 33 00.5 of 5

Not Used

END OF SECTION

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Quality control and control of installation.
- B. Tolerances.
- C. References.
- D. Testing and inspection services.
- E. Manufacturers' field services.
- F. Labeling.
- G. Examination.
- H. Preparation.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Perform Work by persons qualified to produce required and specified quality.
- E. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.
- F. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.03 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. **Do not permit tolerances to accumulate.**
- B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES

- A. For products or workmanship specified by association, trade or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.05 MANUFACTURERS' FIELD SERVICES

- A. Provide manufacturers field services where individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations. Observer subject to approval of Architect/Engineer.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Refer to Section 01 33 00 – Submittal Procedures “Manufacturers' Field Reports” article.

1.06 LABELING

- A. Attach label from agency approved by authority having jurisdiction for products, assemblies and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification and the following information, as applicable, on each label:
 - 1. Model number.
 - 2. Serial number.
 - 3. Performance characteristics.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Verify utility services are available, of correct characteristics, and in correct locations.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer or conditioner prior to applying new material or substance in contact or bond.

END OF SECTION

SECTION 01 45 23 – CONCRETE IN-SITU RELATIVE HUMIDITY AND PH TESTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Provide in-situ concrete relative humidity and surface pH testing to all concrete specified to be covered with floor coverings or resinous coatings. Includes concrete placed below, on and above grade
 - 1. At lightweight concrete floors, provide in-situ concrete relative humidity and pH tests.
- B. Testing shall take place after allowing concrete to dry for a minimum of 90 days. Testing to be scheduled no less than one and no more than three weeks prior to scheduled flooring installation.

1.02 RELATED SECTIONS

- A. Section 09 30 00 – Tiling.
- B. Section 09 65 00 – Resilient Flooring.
- C. Section 09 68 13 – Tile Carpeting.

1.03 REFERENCES

- A. ASTM F2170-11 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes
- B. ASTM F710-05 – Standard Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.

1.04 SUBMITTALS

- A. Report all test results in chart form listing test dates, time, depth of test well, in-situ temperature, relative humidity and pH levels.
- B. List test locations on chart and show same on floor plan.
- C. Deliver results in duplicate for distribution to Architect and General Contractor.

1.05 QUALITY ASSURANCE

- A. Independent Testing Agency
 - 1. Certified by the International Concrete Restoration Institute as a Tier 2 concrete moisture-testing technician.
 - 2. Other agency with verifiable experience
- B. Digital Meter and Calibrated Humidity probes

1. Minimum two-point probe calibration
- C. Wide range pH paper, and distilled or de-ionized water.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Humidity and Temperature probe kit as manufactured by Vaisala or equal.
- B. pH test paper as manufactured by Micro Essential Laboratory or equal.

PART 3 EXECUTION

3.01 QUANTIFICATION OF RELATIVE HUMIDITY

- A. The test site should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period. If meeting this criterion is not possible, then minimum conditions should be 75 ± 10 degrees F and 50 ± 10 percent relative humidity. When a building is not under HVAC control, a recording hygrometer or data logger shall be in place recording conditions during the test period. A transcript of this information must be included with the test report.
- B. The number of in-situ relative humidity test sites is determined by the square footage of the facility. Perform three tests for the first 1,000 square feet and one additional test for each additional 1,000 square feet.
- C. Determine the thickness of the concrete slab, typically from construction documents.
- D. Utilizing a roto-hammer drill test holes to the appropriate depth as follows:
 1. Slab drying from top only (slab on grade, slab on metal deck) drill-to depth from top of slab 40 percent of slab thickness.
 2. Slab drying from top and bottom (elevated structural slab not poured in metal deck) drill-to depth from top of slab 20 percent of slab thickness.
 3. Hole diameter shall not exceed outside diameter of the insertable test sleeve by more than 0.04 inch. Drilling operation must be dry.
- E. Vacuum all concrete dust from test hole.
- F. Insert a hole liner, or sleeve, to the full depth of test hole, assuring that the liner is capped or plugged at the end protruding from the concrete surface.
- G. Permit the test site to acclimate or equilibrate for 72 hours prior to taking relative humidity readings.
- H. Remove the sleeve plug and place a probe into the sleeve assuring that it reaches the bottom of the test hole. The test probe must be at temperature equilibration with the

concrete slab.

- I. Read and record temperature and relative humidity at the test site.

3.02 QUANTIFYING PH LEVEL

- A. At or near the relative humidity test site perform pH test.
 1. Place several drops of water onto the concrete surface to form a puddle approximately 1 inch in diameter.
 2. Allow the water to set for approximately 60 seconds.
 3. Dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading
- B. Record and report results.

END OF SECTION

SECTION 01 45 29 – TESTING LABORATORY SERVICES FOR STRUCTURAL TESTS AND SPECIAL INSPECTIONS

PART 1 GENERAL

1.01 SCOPE

- A. A qualified independent testing laboratory and inspection agency and/or geotechnical engineering service, selected and paid by Owner and approved by Architect, will perform special inspection, professional testing and laboratory services specified herein.
- B. Testing and inspecting agency shall make and perform all inspections and tests in accordance with the rules and regulations of Building Code, local authorities, Specifications of ASTM, and these Contract Documents.
- C. Materials and workmanship not meeting required standards or performance obligations are to be removed and replaced. Replacement and subsequent testing shall be at Contractor's expense.
- D. Where terms "Special Inspector," "Inspector" and "Laboratory" are used, they mean and refer to an officially designated and accredited inspector of testing laboratory or geotechnical service engaged by Owner.
- E. Where the term "Geotechnical Service" is used, it means an agency specializing in soil analysis and professional geotechnical engineering, which is under the direction of a licensed engineer or licensed geologist and which is retained by the Owner for construction phase testing and inspection of foundation construction and earthwork. It may be the same agency as the laboratory.
- F. Where the term "Geotechnical Engineer" is used, it means the licensed design professional in responsible charge of the subsurface investigation and report from which the building foundation system is derived. He may be a member of the geotechnical service engaged by the Owner to perform construction phase services.
- G. Testing, inspection and certifications specified in other sections of these Specifications shall be paid by Contractor, unless otherwise indicated, and shall be by agencies approved by Architect.
- H. Laboratory inspection shall not relieve Contractor or fabricator of his responsibility to furnish materials and workmanship in accordance with Contract Documents.

1.02 QUALIFICATIONS

- A. Testing and inspecting agencies shall meet requirements of ASTM E329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction" and ASTM E543, "Standard Practice for Agencies Performing Nondestructive Testing." Special inspectors shall be qualified persons who have demonstrated competence to the satisfaction of the building official for inspection of the particular type of construction requiring special inspection.
- B. Testing and inspecting agencies shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than \$500,000.00.

- C. Special inspection and testing services of testing agency shall be under the direction of a Licensed Engineer licensed in the State of Texas, charged with engineering managerial responsibility and having at least 5 years of engineering experience in inspection and testing of construction materials.
 - 1. Laboratory: Authorized to operate in State of Texas.
 - 2. Laboratory Staff: Maintain full-time Registered Engineer on staff to review services.
 - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- D. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by Architect/Engineer or Owner.
- E. Special inspectors monitoring concrete work shall be ACI certified inspectors.
- F. Special inspectors performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors." Special inspector may be supported by assistant special inspectors who may perform specific inspection functions under supervision of the special inspector. Assistant special inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). Work of assistant special inspectors shall be regularly monitored by the special inspector, generally on a daily basis.
- G. Prior to start of Work, submit agency name, address and telephone number, name of full-time licensed Engineer in responsible charge, and name of each Special Inspector who will inspect the work.
- H. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

1.03 RESPONSIBILITIES OF CONTRACTOR

- A. See respective technical sections for specific requirements.
- B. Deliver to the laboratory, without cost to Owner, adequate quantities of representative samples of materials proposed for use which are required to be tested.
- C. Advise inspecting agency and Architect sufficiently in advance of construction operations to allow inspecting agency to complete any required checks or tests and to assign personnel for field inspection and testing as specified.
- D. Notify inspecting agency of each day's construction operations expected to require special inspection, at least 48 hours in advance of such operations, to allow Special Inspector to complete any required checks or tests in a timely manner.
- E. Provide adequate facilities for safe storage and proper curing of concrete test samples on project site for the first 24 hours and also for subsequent field curing, as required by ASTM C31.

- F. Furnish such nominal labor and equipment as is required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for special inspection.
- G. Furnish concrete mix designs, in accordance with ACI 301, Section 3.9, made by an independent testing laboratory or qualified concrete supplier. Where mix designs by an independent testing laboratory are required, laboratory shall be selected and paid by Contractor.
- H. Obtain required inspections or approvals of Building Official. All inspection requests and notifications required by Building Code Section 110 of the 2015 IBC are responsibility of Contractor.
- I. Provide current welder certifications for each welder to be employed.
- J. Furnish fabrication/erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6.
- K. Submit prequalification of all welding procedures to be used in executing the work.
- L. Review and sign the Statement of Special Inspections in conjunction with other responsible parties prior to the initiation of construction.
- M. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.
- N. Retesting or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by Architect/Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing chargers from Contract Sum/Price.

1.04 AUTHORITY AND DUTIES OF SPECIAL INSPECTOR AND TESTING LABORATORY

- A. Special inspector shall keep records of inspections. The special inspector shall furnish inspection reports to the building official, Contractor, Architect and the registered design professional in responsible charge.
 - 1. Reports shall indicate that work inspected was done in conformance with approved construction documents.
 - 2. Discrepancies shall be brought immediately to the attention of the Contractor for correction.
 - 3. If the discrepancies are not corrected, the discrepancies shall be brought to the attention of the building official and to the Architect prior to the completion of that phase of the work.
 - 4. A final report documenting required special inspections and correction of any discrepancies shall be submitted at a date to be agreed upon prior to the start of work, by the permit applicant and the building official.
- B. Perform all special inspection and testing duties as required by Chapter 17 of the International Building Code and as herein specified.

- C. Special inspector or other representatives of testing laboratory, who have reviewed and are familiar with the project and specifications, shall participate in all preconstruction conferences. They shall coordinate material testing and inspection requirements with Contractor and his subcontractors consistent with planned construction schedule. They shall attend, throughout the course of the project, such conferences as may be required or requested to address quality control issues.
- D. Test and/or inspect the work assigned for conformance with the approved construction documents, specifications and applicable material and workmanship provisions of the building code. Perform testing and inspection in a timely manner to avoid delay of work.
- E. Submit test and/or inspection reports to the Building Official, Contractor, the Architect, the Structural Engineer of Record and other designated persons in accordance with the schedule in the Statement of Special Inspections.
- F. Review and sign the Statement of Special Inspections in conjunction with other responsible parties prior to the initiation of construction.
- G. Laboratory personnel shall inspect and/or test materials, assemblies, specimens, and work performed including design mixes, methods, and techniques and report to Architect progress thereof.
- H. If material furnished and/or work performed fails to meet requirements of Contract Documents, laboratory inspector shall promptly notify both Contractor and Architect of such failure.
- I. Special inspectors do not act as foremen, or perform other duties for Contractor. Work will be checked as it progresses, but failure to detect any defective work or materials shall not, in any way, prevent later rejection when such defect is discovered.
- J. Special inspector is not authorized to revoke, alter, relax, enlarge, or release any requirement of the Contract Documents or to approve or accept any portion of work, except where such approval is specifically called for in Specifications.

1.05 SUBMITTALS

- A. Submit Copies of Reports of Each and Every Inspection and Test as Follows: Owner - 1, Contractor - 2, Architect - 1 and Engineer - 1. Copy concrete cylinder breaks to concrete supplier.
- B. Test Reports Shall Include:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Name of inspector.
 - 4. Date and time of sampling or inspection.
 - 5. Identification of product and specifications section.

6. Location in the Project.
 7. Type of test/inspection.
 8. Date of test/inspection.
 9. Results of test/inspection.
 10. Conformance with Contract Documents.
 11. When requested by Architect, provide interpretation of results.
- C. State in report all details of each inspection and test. Indicate compliance or noncompliance with requirements of Contract Documents. Also state in report any and all unsatisfactory conditions.
- D. In addition to furnishing a written report, notify Contractor verbally of any uncorrected conditions or failures to comply with requirements of Contract Documents and immediately fax or email corresponding report to Architect and Engineer.
- E. At completion of each trade or branch of work requiring inspecting and/or testing, submit an interim report attesting to satisfactory completion of that work and full compliance with requirements of Contract Documents.
- F. Upon completion of all work which requires special inspection, submit a final report documenting required special inspections and correction of any deficiencies noted in the inspections. Final report shall bear the seal of the supervising licensed engineer for the testing and inspection agency.
- G. Submit copies of test results, sealed by a Licensed Engineer, to municipal authorities having jurisdiction, as they may require or request.

1.06 REFERENCED STANDARDS

- A. Latest adopted edition of all standards referenced in this Section shall apply, unless noted otherwise. In case of conflict between these Contract Documents and a referenced standard, Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.
- B. ASTM C1077 – Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
- C. ASTM C1093 – Standard Practice for Accreditation of Testing Agencies for Unit Masonry.
- D. ASTM D3740 – Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- E. ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
- F. ASTM E543 – Standard Practice for Agencies Performing Nondestructive Testing.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 EXISTING CONDITIONS

- A. The testing laboratory shall examine the existing structure in areas where new construction will tie in as defined on the Drawings.
 - 1. General condition of framing in areas to be loaded or altered: Configuration and evidence of excessive corrosion or other damage shall be reported.
- B. Work with the Contractor in regard to accessibility and removal of finishes to permit visual examination of affected areas.
- C. Provide a report indicating acceptability of existing framing before new construction begins.

3.02 PIER DRILLING OPERATION

- A. A representative of the Owner's geotechnical consultant shall provide services herein specified.
- B. Special inspector shall make continuous inspections of drilled pier construction to check the following for compliance with the approved soils report and the Contract Documents:
 - 1. Verify soundness of bearing stratum and desired penetration.
 - 2. Verify placement locations, plumbness and pier dimensions including shaft diameter and length.
 - 3. Verify reinforcing steel size, grade, quantity and placement.
 - 4. Monitor condition of hole and removal of water and loose material from bottom. Verify cleanliness/preparation of sides to develop skin friction.
 - 5. Verify compliance with specified time limit regarding how long holes are permitted to stand open, exposed to air, before placing concrete.
 - 6. Monitor placement of concrete and use of tremie or pumps.
 - 7. Monitor the extraction of casing, if used.
- C. Special inspector shall furnish complete pier log showing diameter, top and bottom elevations of each pier, casing required or not required, bell size, actual penetration into bearing stratum, elevation of top of bearing stratum, volume of concrete used, and deviations from specified tolerances.

3.03 BUILDING PAD

- A. A representative of the Owner's geotechnical consultant shall perform testing and

inspection specified herein, unless noted otherwise. Inspections at the jobsite shall be carried out by a designated special inspector in accordance with the Building Code.

- B. Contractor shall make available to geotechnical service, free of charge, adequate samples of each fill and backfill material from proposed sources of supply.
- C. A 50-pound sample of each type of off-site and site-excavated material proposed for use shall be given to geotechnical service by Contractor between 10 and 30 calendar days prior to start of specified work. Analyze samples as required to provide a soil description and to determine compliance with gradation and quality requirements, and test as follows:
 - 1. Tests for liquid limit of soils in accordance with ASTM D4318.
 - 2. Tests for plastic limit of soils and plasticity index of soils in accordance with ASTM D4318.
 - 3. Tests for moisture/density relations of soil in accordance with ASTM D698 or D1557, as applicable.
- D. Furnish a report for each individual test, describing variances from specified requirements and state whether material is acceptable for intended use.
- E. Inspect underslab drainage material and placement for compliance with specified gradation, quality and compaction.
- F. Inspect excavated subgrade, confirm elevation and identify to Contractor any remaining unsuitable material which must be removed, and any soft areas which must be recompacted.
- G. Inspect and test prepared subgrade after initial rolling and compaction of scarified surface, before the placement of any fill.
- H. Continuously inspect placement, lift thickness and compaction of all fill materials, including continuous inspection of moisture conditioning of onsite soils. Verify fill material compliance with specified material properties.
- I. Make in-place compaction test for moisture content and density relations, and density of materials-in-place to determine that backfill and fill materials have been compacted to specified density. Tests shall be made at the following frequencies:
 - 1. One test for each 5000 square feet of area of each lift placed under building or floor slab. Stagger test locations in each lift from those in previous lift. A minimum of three tests will be required of each lift.
 - 2. One test for each 100 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered as above.
 - 3. One test of each lift placed below any isolated footing or similar support and every 100 linear feet under continuous footings, with locations taken on a different side in each case, from the lift below.
- J. Check and report on compliance with the approved soils report and the Contract Documents. Reports may be combined on a daily basis, if desired, provided that location

of each test and applicable lift are clearly identified and any problems are detailed.

3.04 FOOTING EXCAVATIONS

- A. The geotechnical service shall provide a special inspector who shall periodically inspect each concrete footing excavation to determine that proper bearing stratum is obtained, that material below footings are adequate to achieve the design bearing capacity, and that excavations are properly clean and dry before concrete is placed.

3.05 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES

- A. A special inspector shall perform testing and inspection specified herein.
- B. Welds shall be inspected by a certified welding inspector.
- C. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with Contract Documents and approved Shop Drawings. All instances of noncompliance with Contract Documents and approved Shop Drawings shall be immediately brought to Contractor attention for correction and then, if uncorrected, reported to Architect.
- D. Observe and Report on the Following:
 - 1. Number and size of bars. Include spacing of stirrups and column ties.
 - 2. Bending and lengths of bars.
 - 3. Splicing.
 - 4. Clearance to forms including chair heights.
 - 5. Clearance to sides and bottom of trench if soil-formed.
 - 6. Clearance between bars or spacing.
 - 7. Rust, form oil, and other contamination.
 - 8. Grade of steel. Verify that reinforcing being welded is ASTM A706.
 - 9. Securing, tying and chairing of bars.
 - 10. Excessive congestion of reinforcing steel.
 - 11. Installation of anchor bolts and placement of concrete around such bolts.
 - 12. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
 - 13. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals that a sound weld or a full 360 degree fillet has not been obtained for a particular stud or bar, such stud or bar shall be struck with a hammer and bent 15 degrees off perpendicular and then bent back

into position. Anchors failing this test shall be replaced.

- E. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years of experience inspecting reinforcing steel in projects of similar size.

3.06 CONCRETE INSPECTION AND TESTING

- A. A special inspector shall perform testing and inspection specified herein, unless otherwise noted. Comply with ACI 311, "Guide for Concrete Inspection" and "ACI Manual of Concrete Inspection" SP-2.
- B. Receive and evaluate all proposed concrete mix designs submitted by Contractor. If mix designs comply with Drawings and Specifications, laboratory shall submit a letter to Architect certifying compliance. Mix designs not complying with Drawings and Specifications shall be returned by laboratory as unacceptable.
- C. Periodically inspect formwork for shape, location and dimensions of the concrete member being formed.
- D. Verify use of the required mix design.
- E. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.
- F. Mold and cure 3 specimens from each sample in accordance with ASTM C31. Supervise curing and protection provided (by others) for test specimens in field, and transportation from field to laboratory. Test cylinders shall be stored in the field 24 hours and then be carefully transported to laboratory and cured in accordance with ASTM C31.
- G. Test specimens in accordance with ASTM C39. Two specimens shall be tested at 28 days for acceptance and 1 shall be tested at 7 days for information.
- H. Make 1 strength test (3 cylinders) for each 100 cubic yards, or fraction thereof, of each mix design of concrete placed in any 1 day.
- I. Make 1 slump test for each set of cylinders following procedural requirements of ASTM C143 and C172. Make additional slump tests whenever consistency of concrete appears to vary. Do not permit placement of concrete having a measured slump outside limits given on Drawings, except when approved by Architect. Slump tests corresponding to samples from which strength tests are made shall be reported with strength test results. Other slump tests need not be reported.
- J. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.
- K. Determine temperature of concrete sample for each strength test.
- L. Testing agency shall provide a competent inspector at the batch plant to observe the mixing of the first batch of each mix design destined for the project. Inspector shall examine concrete materials for compliance with Specifications and approved mix design, weighing and measuring devices, proportioning and mixing of materials, water and cement content, general operation of plant, and transportation of concrete to jobsite. Inspector shall verify that amount of free surface moisture contained in both fine and coarse aggregate has been

properly accounted for in concrete proportioning to achieve required consistency and water cement ratio. Once proper procedures and quality assurance program have been confirmed by the inspector, in-plant inspections may cease.

- M. Testing laboratory shall monitor addition of water to concrete at jobsite and length of time concrete is allowed to remain in the truck before placement. Inspector shall compare mixture with criteria on approved mix design and report any significant deviation to Architect, Contractor and concrete supplier. Do not permit addition of water which will exceed maximum water/cement ratio for the mix as given on approved mix design.
- N. Continuously observe placing of all concrete, except non-structural slabs-on-grade and sitework. Observe and report on placing method, consolidation, cold joints, length of drop, and displacement of reinforcement. Report deficiencies to Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by laboratory.
- O. Testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or poured), amount of water added and time at which cement and aggregate was dispensed into truck, and time at which concrete was discharged from truck.
- P. Evaluation and Acceptance:
1. If measured slump, or air content of air entrained concrete, falls outside specified limits a check test shall be made immediately on another portion of same sample. In the event of a second failure, concrete shall be considered to have failed to meet requirements of the specifications, and shall not be used in structure.
 2. Strength level of concrete will be considered satisfactory if averages of all sets of three consecutive strength test results are equal to, or exceed, specified strength and no individual test result (average of two cylinders) is below specified strength by more than 500 psi.
- Q. Concrete Test Reports:
1. Reports shall be made and distributed immediately after respective tests or inspections are made.
 2. Where reports indicate deviations from Contract Documents, they shall also include a determination of probable cause of deviation and, where applicable, a recommendation for corrective action.
 3. Whenever testing laboratory recognizes a trend of decreasing quality in concrete due to changing seasons, conditions of curing, or other cause, this shall be brought to Architects attention, along with a recommendation for corrective action to be taken before materials fall below requirements of Specifications.
- R. Comply with ACI 311, "Guide for Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).
- S. Inspect application of curing compound and monitor all curing conditions to assure compliance with specification requirements. Report curing deficiencies to Contractor immediately and submit a written report to Architect.

3.07 POST-TENSIONING OF CONCRETE

- A. Verify certification of calibration of jacking equipment used in post-tensioning operations.
- B. Observe and report on placement and anchorage of tendons immediately prior to concreting.
- C. Verify periodically the strength of in-situ concrete strength prior to stressing of tendons and prior to removal of shores and forms from horizontal framing.
- D. Provide a qualified, experienced special inspector to observe stressing and elongation measurement of each tendon. Inspector shall have a minimum of 3 years of experience inspecting post-tensioning operations.
- E. Special inspector shall log and submit detailed reports of stressing and elongation of each tendon.
- F. Compare actual and required elongation of each tendon and actual and required load on each tendon. Grant permission to cut tails of tendons which are within specified tolerance, unless otherwise noted on Drawings, and submit reports of those which are not within specified tolerance, along with recommended corrective action, to Architect for further elevation. Forward a copy of all stressing reports to Architect for record.

3.08 TESTING NON-SHRINK GROUT

- A. Make one strength test for every 10 base plates grouted and for every 10 bags of grout used in joints between members.
- B. Each test shall consist of four cubes, two to be tested at seven days and two at 28 days, made and tested in accordance with ASTM C109, with the exception that grout shall be restrained from expansion by a top plate.

3.09 MASONRY

- A. Inspection:
 - 1. Provide a qualified inspector to inspect all structural masonry work on a periodic basis. Inspect work in progress at least once for each 5,000 square feet of wall laid, but not less than once each day, to check compliance with Contract Documents and applicable Building Code.
 - 2. Inspect the following:
 - a. Preparation of masonry prisms for testing.
 - b. All reinforcing steel (during or after placement).
 - c. Grout spaces (prior to grouting and prior to closing cleanouts).
 - d. Mortar mixing operations.
 - e. Bedding of mortar for each type of unit and placing of units.
 - f. Grouting operations.
 - g. Condition of units before laying for excessive absorption.
 - 3. Provide a report of each inspection.
- B. Field Compressive Tests for Grout:

1. Secure composite samples of grout at jobsite in accordance with ASTM C1019. Measure the slump at time of sampling in accordance with ASTM C143.
2. Mold and cure three specimens from each sample in accordance with ASTM C1019. Supervise curing protection provided (by others) for test specimens in the field and transportation from field to laboratory. Test specimens shall be stored in the field 48 hours and then be carefully transported to laboratory and cured in a moist room conforming to ASTM C511.
3. Cap and test specimens in accordance with ASTM C39. Two specimens shall be tested at 28 days for acceptance and one specimen shall be tested at seven days for information.
4. Make one strength test (three specimens) for each 10 cubic yards of grout placed but not less than one strength test for each 5,000 square feet of wall area.

C. Prism Tests:

1. Make prism tests in advance of operations using materials under same conditions and with same bonding arrangement as for structure. Observe and inspect actual construction of prisms. Moisture content of unit at time of laying, consistency of mortar, and width and thickness of mortar joints shall be same as used in structure.
2. Cure and test prisms in accordance with applicable provisions of ASTM C1314. Test five specimens of each type of masonry unit before delivering material to jobsite and submit results for approval. During construction, test three specimens of each type of masonry unit for each 5,000 square feet of wall placed.
3. Standard age of test specimens is 28 days, but seven-day tests may be used, provided relationship between seven day and 28-day strengths is established by test for materials used.
4. Build prisms of hollow masonry units the same width as unit by 16 inches long in plan and 16 inches high, using specified masonry units, applying mortar to only face shells. Do not fill hollow core with grout. Compute value of ultimate net compressive strength by dividing ultimate load by net face shell area of masonry units (length X twice face shell thickness).
5. Build brick prisms one brick width and length in plan and five bricks high, using full bed joints as specified. Compute ultimate compressive strength by dividing ultimate load by net area of masonry units.
6. Build prisms on job using same materials and methods as for wall construction. Store prisms in a place where they will be undisturbed for two days and have approximately same curing conditions as wall construction. After two days, transport to laboratory in a manner which will not disturb mortar bond and then cure and test as set forth under ASTM C1314.
7. When average strength of a set of prisms falls below specified compressive strength (F'_m), masonry corresponding to the test shall be deemed unacceptable. In such case, notify Architect and Contractor immediately.

3.10 STRUCTURAL STEEL

- A. Inspect structural steel during fabrication and during and after erection for conformance with Contract Documents and Shop Drawings. Review and report on fabricator's quality control procedures and capabilities.
- B. Shop Inspection:
 - 1. Periodic inspection of fabrication process, including welding, to monitor effectiveness of quality control program. Inspection of shop welding to be "verification inspection," in accordance with AWS D1.1, Chapter 6.
 - 2. Continuous inspection of complete and partial penetration groove welds, multi-pass fillet welds and single-pass fillet welds greater than 5/16 inch.
 - 3. Ultrasonic testing of all full penetration welds.
 - 4. Examination of installation of shop welded shear studs.
- C. Field Inspection:
 - 1. Proper erection of all pieces.
 - 2. Proper installation of all bolts, including checking of calibration of impact wrenches used with high-strength bolts.
 - 3. Plumbness of structure and proper bracing.
 - 4. Proper painting and galvanizing.
 - 5. Continuous inspection of welding process for penetration welds and fillet welds larger than 5/16 inch, and periodic inspection of all other welding while in progress.
 - 6. Application of joint details at each connection
 - 7. Visual examination of all completed welds.
 - 8. Ultrasonic testing of all penetration field welds.
 - 9. Installation of field welded shear studs.
 - 10. Inspect all shop-fabricated members, upon arrival at jobsite, for member straightness and alignment and for defects incurred during transit and handling.
 - 11. Measure and record camber of all beams upon arrival and before erection for compliance with specified camber. Measure lying flat with web horizontal. Members outside specified camber tolerance shall be returned to shop for correction.
 - 12. Proper grouting of column base plates.
- D. Qualifications of Welders: Fabricator and erector shall provide testing laboratory with names of welders to be employed on work, along with certification that each welder has passed qualification tests within the last year, using procedures covered in American Welding Society "Structural Welding Code – Steel," D1.1, latest edition. Verify all welder

qualifications.

E. Inspection of Field Welding Shall Include the Following:

1. Visually inspect fillet welds for size, soundness and proper return around ends. Check for seams, folds and delaminations.
2. Ultrasonically test all penetration welds in accordance with ASTM E164.
3. Inspect surfaces to be welded. Surface preparations, fit-up and cleanliness of surface shall be noted. Electrodes shall be checked for size, type and condition.
4. Welding inspector shall be present during alignment and fit-up of members being welded, and shall check for correct surface preparation of root openings, sound weld metal, and proper penetration in root pass. Where weld has not penetrated completely, inspector shall order joint to be chipped down to sound metal, or gouged out, and re-welded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to 2 inches beyond each end of crack.
5. Inspector shall check that all welds have been marked with welder's symbol and shall mark welds requiring repairs and shall make a re-inspection. Inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector. Unacceptable material and work shall be identified by word "reject" or "repair" marked directly on material.
6. Testing agency shall advise Owner and Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other than specified. Such further tests and examinations shall be performed as authorized by Owner and Architect.
7. Owner reserves the right to use ultrasonic or radiographic inspection to verify adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.
8. All welded connections between primary members of ductile moment resisting space frames shall be tested for compliance with UBC Standard No. 27-6 in addition to project specifications. As a minimum this shall include:
 - a. Ultrasonic or radiographic testing of all full penetration welds contained in joints and splices.
 - b. Ultrasonic or radiographic testing of partial penetration groove welds used in column splices.
 - c. When subjected to through thickness weld shrinkage strains, base metal thicker than 1-1/2 inches shall be ultrasonically inspected for discontinuities behind such welds after joint completion.
 - d. Any material discontinuities shall be accepted or rejected on basis of the defect rating in accordance with (larger reflector) criteria of UBC Standard No. 27-6.

F. Inspection of Bolted Construction Shall be in Accordance with AISC Specification for Structural Steel Buildings and as Follows:

1. All bolts shall be visually inspected to ensure plies have been brought into snug

contact.

2. High-strength bolting shall be inspected in accordance with Section 9 of "Specifications for Structural Joints Using ASTM A325 or A490 Bolts."
 3. For all high-strength bolts, unless specifically noted on Drawings to require only "snug-tight" installation, inspector shall observe required jobsite testing and calibration, and shall confirm procedure to be used does provide required tension. He then shall monitor the work to assure tested procedures are routinely followed. Tightening by calibrated wrench and turn-of-the-nut method without match-marking shall be continuously inspected.
 4. For slip-critical connections, inspect contact surfaces for compliance with specifications prior to bolting.
 5. Verify markings on bolts, nuts and washers to comply with ASTM Standards,
- G. Inspection of Stud Welding Shall be in Accordance with Section 7.8, of the AWS Structural Welding Code, D1.1, and as follows:
1. A minimum of two shear studs shall be welded at start of each production period in order to determine proper generator, control unit and stud welder setting. These studs shall be capable of being bent 45 degrees from vertical without weld failure.
 2. When temperature is below 32 degrees F, one stud in each 100 shall be tested after cooling. Studs shall not be welded below 0 degrees F or when surface is wet with rain or snow. If stud fails in weld, two new studs shall pass the test before resumption of welding.
 3. Visually inspect studs for compliance with Contract Documents. Check number, spacing and weld quality. If, after welding, visual inspection reveals a sound weld or a full 360-degree fillet has not been obtained for a particular stud, such stud shall be struck with a hammer and bent 15 degrees off perpendicular in the direction away from missing weld. Studs failing this test shall be replaced.

3.11 EXPANSION BOLT INSTALLATION

- A. Inspect drilling of each hole and installation of each expansion bolt, including hole size, hole preparation, number, spacing, anchor size, installation of grout or adhesive (where applicable) and anchor installation, for compliance with Contract Documents and shop drawings.
- B. Verify installation torque for each expansion bolt for compliance with manufacturer's installation instructions.

3.12 OPEN WEB JOISTS

- A. Inspect all joists either in plant or at jobsite for conformance with specified fabrication requirements. Check welded connections between web and chord, splices and straightness of members.
- B. Inspect installation of joists at jobsite. Check connections to supporting members, chord extensions, number of rows of bridging, and bridging connections for conformance with

Contract Documents and referenced standards.

- C. Inspect manufacturer's certificate of compliance.
- D. Check welder qualification certificates for both shop and field welding operators.

3.13 METAL FLOOR DECK

A. Field Inspection Shall Consist of the Following:

1. Check types, gauges and finishes for conformance with Contract Documents and Shop Drawings.
2. Examination for proper erection of all metal deck, fastenings, reinforcing of holes, deck reinforcing, miscellaneous deck supports, hanger tabs, shear studs, deck closures, painting or other coating.
3. Certification of welders.
4. Field welded shear studs used to fasten metal floor decking to supporting steel shall be inspected and tested as described in the paragraph addressing structural steel.

3.14 METAL ROOF DECK

A. Field Inspection Shall Consist of the Following:

1. Checking types, gauges and finishes for conformance with Contract Documents and Shop Drawings.
2. Examination for proper erection of all metal deck, including fastenings at supports and side laps, reinforcing of holes, and miscellaneous deck supports.
3. Certification of welders, under AWS D1.3 "Structural Welding Code – Sheet Steel."
4. Visual inspection of at least 25 percent of all welds.

3.15

3.16

3.17 EXTERIOR INSULATION AND FINISH SYSTEM (EIFS) WATER-RESISTIVE BARRIER COATING

- A. A water-resistive barrier coating complying with ASTM E2570 shall be inspected when installed over a sheathing substrate.

3.18 CONCRETE IN-SITU RELATIVE HUMIDITY, AND Ph TESTING

- A. Refer to Section 01 45 23 for requirements.

3.19

3.20 PENETRATION FIRESTOPS AND FIRE-RESISTANT JOINT SYSTEMS

- A. Refer to Section 07 84 00- Firestopping for requirements for inspecting and testing penetration firestop systems and fire-resistant joint systems.

END OF SECTION

SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities:
 - 1. Temporary electricity.
 - 2. Temporary lighting for construction purposes.
 - 3. Temporary heating.
 - 4. Temporary cooling.
 - 5. Temporary ventilation.
 - 6. Telephone service.
 - 7. Temporary water service.
 - 8. Temporary sanitary facilities.
- B. Construction Facilities:
 - 1. Field offices and sheds.
 - 2. Vehicular access.
 - 3. Parking.
 - 4. Progress cleaning and waste removal.
 - 5. Project identification.
 - 6. Traffic regulation.
 - 7. Fire prevention facilities.
- C. Temporary Controls:
 - 1. Barriers.
 - 2. Enclosures and fencing.
 - 3. Security.
 - 4. Water control.
 - 5. Dust control.

6. Erosion and sediment control.
7. Noise control.
8. Pest control.
9. Pollution control.
10. Rodent control.

D. Removal of utilities, facilities and controls.

1.02 TEMPORARY ELECTRICITY

- A. Owner will pay cost of energy used. Exercise measures to conserve energy.
- B. Provide temporary electric feeder from electrical service at location as directed by Owner. Do not disrupt Owner's use of service.
- C. Complement existing power service capacity and characteristics as required for construction operations.
- D. Provide power outlets, with branch wiring and distribution boxes located as required for construction operations. Provide flexible power cords as required for portable construction tools and equipment.
- E. Provide main service disconnect and over-current protection at convenient location.
- F. Permanent convenience receptacles may not be utilized during construction.
- G. Provide distribution equipment, wiring and outlets to provide single phase branch circuits for power and lighting.
 1. Provide 20 ampere duplex outlets, single phase circuits for power tools for every 500 square feet of active work area.
 2. Provide 20 ampere, single-phase branch circuits for lighting.

1.03 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain incandescent lighting for construction operations to achieve minimum lighting level of 2 watts/ square feet.
- B. Provide and maintain 1 watt/ square feet lighting to entire site after dark for security purposes.
- C. Provide and maintain 0.25 watt/ square feet HID lighting to interior work areas after dark for security purposes.
- D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtailed, and lamps for specified lighting levels.
- E. Maintain lighting and provide routine repairs.

- F. Permanent building lighting may not be utilized during construction.

1.04 TEMPORARY HEATING

- A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.
- B. Enclose building prior to activating temporary heat in accordance with Enclosures article in this section.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in product sections.

1.05 TEMPORARY COOLING

- A. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations.
- B. Enclose building prior to activating temporary cooling in accordance with Enclosures article in this section.
- C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.06 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors or gases.

1.07 TELEPHONE SERVICE

- A. Provide, maintain and pay for telephone service to field office at time of project mobilization.
- B. Provide, maintain and pay for WiFi service to field office at time of project mobilization for the duration of the project work. Provide access to WiFi to Owner reps and Design Team members.

1.08 TEMPORARY WATER SERVICE

- A. Owner will pay cost of temporary water. Exercise measures to conserve water. Utilize Owner's existing water system, extend and supplement with temporary devices as needed to maintain specified conditions for construction operations.
- B. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

1.09 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

1.10 FIELD OFFICES AND SHEDS

- A. Office: Weather tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate eight persons.
- C. Locate offices and sheds minimum distance of 30 feet from new structures.
- D. Do not use permanent facilities for field offices or for storage.
- E. Construction: Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps and landings at entrance doors.
 - 1. Construction: Structurally sound, secure, weather-tight enclosures for office and storage spaces. Maintain during progress of Work; remove when no longer needed at completion of Work.
 - 2. Temperature Transmission Resistance of Floors, Walls and Ceilings: Compatible with occupancy and storage requirements.
 - 3. Interior Materials in Offices: Sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.
 - 4. Lighting for Offices: 50 ft C at desktop height, exterior lighting at entrance doors.
 - 5. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.
- F. Environmental Control:
 - 1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions 68 degrees F heating and 76 degrees F cooling.
 - 2. Storage Spaces: Heating and ventilation as needed to maintain products in accordance with Contract Documents; lighting for maintenance and inspection of products.
- G. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and for inspection of products to requirements of Section 01 60 00 – Product Requirements.
- H. Preparation: Fill and grade sites for temporary structures sloped for drainage away from buildings.
- I. Installation:
 - 1. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
 - 2. Parking: Two hard surfaced parking spaces for use by Owner and Architect/Engineer, connected to office by hard surfaced walk.
 - 3. Employee Residential Occupancy: Not allowed on Owner's property.

- J. Maintenance and Cleaning:
 - 1. Daily janitorial services for offices; periodic cleaning and maintenance for office and storage areas.
 - 2. Maintain approach walks free of mud, water and snow.
- K. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

1.11 VEHICULAR ACCESS

- A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.
- B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
- C. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.
- D. Location approved by Owner.
- E. Provide unimpeded access for emergency vehicles. Maintain 20-foot-wide driveways with turning space between and around combustible materials.
- F. Provide and maintain access to fire hydrants and control valves free of obstructions.
- G. Provide means of removing mud from vehicle wheels before entering streets.
- H. Do not use designated existing on-site roads for construction traffic.

1.12 PARKING

- A. Provide temporary gravel surface parking areas to accommodate construction personnel.
- B. Locate as approved by Owner.
- C. When site space is not adequate, provide additional offsite parking.
- D. Use of designated existing onsite streets and driveways used for construction traffic is not permitted. Tracked vehicles not allowed on paved areas.
- E. Use of designated areas of existing parking facilities used by construction personnel is not permitted.
- F. Do not allow heavy vehicles or construction equipment in parking areas.
- G. Do not allow vehicle parking on existing pavement.
- H. Permanent Pavements and Parking Facilities:

1. Prior to Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
 2. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.
 3. Use of permanent parking structures is not permitted.
- I. Maintenance:
1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow and ice.
- J. Removal, Repair:
1. Remove temporary materials and construction before Substantial Completion.
 2. Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
 3. Repair existing facilities damaged by use, to original condition.
- K. Mud from Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.13 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris and rubbish. Maintain site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing spaces.
- C. Broom and vacuum clean interior areas prior to start of surface finishing and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris and rubbish from site weekly and dispose off-site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 PROJECT IDENTIFICATION

- A. Project Identification Sign:
1. One painted sign, 32 square feet area, and bottom 6 feet above ground.
 2. Content:
 - a. Project number, title, logo and name of Owner as indicated on Contract Documents.
 - b. Names and titles of authorities.
 - c. Names and titles of Architect/Engineer and Consultants.

- d. Name of Prime Contractor.
3. Graphic Design, Colors, Style of Lettering: Designated by Architect/Engineer.
- B. Project Informational Signs:
 1. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering for legibility at 100-foot distance.
 2. Provide sign at each field office, storage shed and directional signs to direct traffic into and within site. Relocate as Work progress requires.
 3. No other signs are allowed without Owner permission except those required by law.
- C. Design sign and structure to withstand 60 miles/hour wind velocity.
- D. Sign Painter: Experienced as professional sign painter for minimum three years.
- E. Finishes, Painting: Adequate to withstand weathering, fading and chipping for duration of construction.
- F. Show content, layout, lettering, color, foundation, structure, sizes and grades of members.
- G. Sign Materials:
 1. Structure and Framing: New wood, structurally adequate.
 2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inch thick, standard large sizes to minimize joints.
 3. Rough Hardware: Galvanized.
 4. Paint and Primers: Exterior quality; two coats; sign background white.
 5. Lettering: Exterior quality paint; contrasting colors.
- H. Installation:
 1. Install project identification sign within 15 days after date fixed by Notice to Proceed.
 2. Erect at location of high public visibility adjacent to main entrance to site.
 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
 4. Install sign surface plumb and level, with butt joints. Anchor securely.
 5. Paint exposed surfaces of sign, supports and framing.
- I. Maintenance: Maintain signs and supports clean, repair deterioration and damage.

- J. Removal: Remove signs, framing, supports and foundations at completion of Project and restore area.

1.15 TRAFFIC REGULATION

A. Signs, Signals and Devices:

1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authority having jurisdiction.
2. Traffic Cones and Drums, Flares and Lights: As approved by authority having jurisdiction.
3. Flagperson Equipment: As required by authority having jurisdiction.

B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

D. Haul Routes:

1. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
2. Confine construction traffic to designated haul routes.
3. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

E. Traffic Signs and Signals:

1. Provide signs at approaches to site and on site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
2. Provide, operate and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control, and areas affected by Contractor's operations.
3. Relocate as Work progresses to maintain effective traffic control.

F. Removal:

1. Remove equipment and devices when no longer required.
2. Repair damage caused by installation.
3. Remove post settings to depth of 2 feet.

1.16 FIRE PREVENTION FACILITIES

A. Prohibit smoking within buildings under construction.

- B. Establish fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain fire watch before, during and after hazardous operations until threat of fire does not exist.
- C. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
 - 1. Provide minimum one fire extinguisher in every construction trailer and storage shed.
 - 2. Provide minimum one fire extinguisher on roof during roofing operations using heat producing equipment.

1.17 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas.
- B. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

1.18 ENCLOSURES AND FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6-foot-high fence around construction site; equip with vehicular and pedestrian gates with locks.
- C. Exterior Enclosures:
 - 1. Provide temporary weather-tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.19 SECURITY

- A. Security Program:
 - 1. Protect Work, existing premises from theft, vandalism and unauthorized entry.
 - 2. Initiate program at project mobilization.
 - 3. Maintain program throughout construction period until Owner occupancy
- B. Entry Control:
 - 1. Restrict entrance of persons and vehicles into Project site.
 - 2. Allow entrance only to authorized persons with proper identification.
 - 4. Maintain log of workers and visitors, make available to Owner on request.

1.20 WATER CONTROL

- A. Grade site to drain. Maintain excavations free of water. Provide, operate and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.

1.21 DUST CONTROL

- A. Execute Work by methods to minimize raising dust from construction operations.
- B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.22 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize surface area of bare soil exposed at one time.
- C. Provide temporary measures including berms, dikes and drains, and other devices to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.23 NOISE CONTROL

- A. Provide methods, means and facilities to minimize noise produced by construction operations.

1.24 PEST CONTROL

- A. Provide methods, means and facilities to prevent pests and insects from damaging the Work and entering facility.

1.25 POLLUTION CONTROL

- A. Provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.
- B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.26 RODENT CONTROL

- A. Provide methods, means and facilities to prevent rodents from accessing or invading premises.

1.27 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

- A. Remove temporary utilities, equipment, facilities and materials prior to Substantial Completion inspection.
- B. Remove underground installations to minimum depth of 2 feet. Grade site as indicated on Drawings.
- C. Clean and repair damage caused by installation or use of temporary work.
- D. Restore existing and permanent facilities used during construction to original condition.
 - 1. Restore permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART1 GENERAL

1.01 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.

1.02 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

1.03 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement or damage.

1.04 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather-tight, climate-controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Provide bonded off-site storage and protection when site does not permit onsite storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

SECTION 01 70 00 – EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Testing, adjusting and balancing.
- F. Protecting installed construction.
- G. Project record documents.
- H. Operation and maintenance data.
- I. Manual for materials and finishes.
- J. Manual for equipment and systems.
- K. Spare parts and maintenance products.
- L. Product warranties and product bonds.
- M. Maintenance service.

1.02 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.
- B. Provide submittals to Architect/Engineer required by authorities having jurisdiction.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.03 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to

surface and material being cleaned.

- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts and drainage systems.
- F. Clean site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish and construction facilities from site.

1.04 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Architect/Engineer and Owner seven days prior to startup of each item.
- C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to startup, and to supervise placing equipment or system in operation.
- H. Submit a written report in accordance with Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.05 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate Project equipment by a qualified manufacturer's representative who is knowledgeable about the Project.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance and shutdown of each item of equipment at scheduled time and at designated location.

- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- G. Required instruction time for each item of equipment and system is specified in individual sections.

1.06 TESTING, ADJUSTING AND BALANCING

Note to editor: If a mechanical consultant other than O'Connell Robertson's engineers are designing the HVAC system, architect to verify if their outside HVAC engineering consultant has a section 23 05 93 Testing, Adjusting and Balancing or another section that addresses TAB and that within this section they have an article that addresses TAB procurement.

- A. Refer to Section 23 05 93 Testing, Adjusting and Balancing for TAB procurement.
- B. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.07 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.

1.08 PROJECT RECORD DOCUMENTS

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
 - 1. Drawings.
 - 2. Specifications.
 - 3. Addenda.
 - 4. Change Orders and other modifications to the Contract.
 - 5. Reviewed Shop Drawings, Product Data and Samples.

6. Manufacturer's instruction for assembly, installation and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
 1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
 1. Measured depths of foundations in relation to finish floor datum.
 2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 4. Field changes of dimension and detail.
 5. Details not on original Contract Drawings.
- G. Submit documents to Architect/Engineer with claim for final Application for Payment.

1.09 OPERATION AND MAINTENANCE DATA

- A. Submit data bound in 8-1/2 by 11 inch (A4) text pages, three-ring capacity expansion binders with durable plastic covers.
- B. Prepare binder cover with printed title "Operation and Maintenance Instructions," title of project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 1. Part 1: Directory, listing names, addresses and telephone numbers of Architect/Engineer, Contractor, subcontractors and major equipment suppliers.

2. Part 2: Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses and telephone numbers of subcontractors and suppliers. Identify the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
3. Part 3: Project documents and certificates, including the following:
 - a. Shop Drawings and product data.
 - b. Air and water balance reports.
 - c. Certificates.
 - d. Originals of warranties and bonds.

1.10 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes in final form within 10 days after final inspection.
- E. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition and color and texture designations. Include information for re-ordering custom manufactured products.
- F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance and repair.
- H. Additional Requirements: As specified in individual product specification sections.
- I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.11 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within 10 days after acceptance.
- C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes in final form within 10 days after final inspection.
- E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- F. Panelboard Circuit Directories: Provide electrical service characteristics, controls and communications by label machine.
- G. Include color coded wiring diagrams as installed.
- H. Operating Procedures: Include startup, break-in and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown and emergency instructions. Include summer, winter and special operating instructions.
- I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing and checking instructions.
- J. Include servicing and lubrication schedule, and list of lubricants required.
- K. Include manufacturer's printed operation and maintenance instructions.
- L. Include sequence of operation by controls manufacturer.
- M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- N. Include control diagrams by controls manufacturer as installed.
- O. Include Contractor's Coordination Drawings, with color-coded piping diagrams as installed.
- P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- R. Include test and balancing reports as specified in Section 01 40 00 - Quality Requirements.
- S. Additional Requirements: As specified in individual product specification sections.

- T. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.12 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance and extra products in quantities specified in individual specification sections.
- B. Deliver to Project site and place in location as directed by Owner; obtain receipt prior to final payment.

1.13 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers and manufacturers, within ten days after completion of applicable item of work.
- B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include Table of Contents and assemble in three-ring binder with durable plastic cover.
- F. Submit prior to final Application for Payment.
- G. Time of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.14 MAINTENANCE SERVICE

- A. Furnish service and maintenance of components indicated in specification sections for one year from date of Substantial Completion unless otherwise specified in the individual specification section.
- B. Examine system components at frequency consistent with reliable operation. Clean, adjust and lubricate as required.
- C. Include systematic examination, adjustment and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.

- D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of Owner.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- A. The work under this Section is subject to requirements of the Contract Documents including Divisions 00 and 01.

1.2 DESCRIPTION

- A. Commissioning is a systematic process of ensuring all building systems perform interactively according to design intent and Owner's operational needs. Commissioning will encompass and coordinate traditionally separate functions of system documentation, installation checkout, equipment start-up, control system calibration and point-to-point checkout, testing and balancing, and functional performance testing. Commissioning is intended to achieve the following specific objectives according to the Contract Documents:
 - 1. Verify and document systems are installed and operate in accordance with the Contract Documents.
 - 2. Ensure O&M, maintenance training, and commissioning documentation requirements are complete.
 - 3. Provide Owner with functional buildings and/or systems with minimal operational problems at time of move-in.
- B. Commissioning does not take away from or reduce responsibility of system designers or installing contractors to provide a finished and fully functioning product.
- C. This section shall in no way diminish the responsibility of the Division 20, 21, 22, 23, 26, 27 and 28 Contractors, Subcontractors and Suppliers in performing all aspects of work and testing as outlined in the contract documents. Any requirements outlined in this section are in addition to requirements outlined in Division 20, 21, 22, 23, 26, 27, 28, and other applicable Divisions of the Specifications.

1.3 ABBREVIATIONS

- A. The following are common abbreviations used in the Specifications (definitions are found further in this Section):
 - 1. A/E - Architect and Design Engineers
 - 2. AEGB – Austin Energy Green Building
 - 3. BAS – Building Automation System
 - 4. BOD – Basis of Design
 - 5. BST – Black Site (Emergency Power) Test
 - 6. CxA – Commissioning Agent
 - 7. CM – Construction Manager
 - 8. CxT – Commissioning Team
 - 9. Cx – Commissioning

10. Cx Plan – Commissioning Plan
11. CC – Controls Contractor
12. EC – Electrical Contractor
13. FPT – Functional Performance Test
14. MC – Mechanical Contractor
15. OR – Owner's Representative
16. OPR – Owner's Project Requirements
17. PFC – Pre-functional checklist
18. TAB – Test, Adjust and Balance
19. RFI – Request for Information

1.4 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.
- B. Acceptance Phase: Phase of construction after startup and initial checkout when Functional Performance Tests, O&M documentation review and training occur.
- C. Basis-of-Design (BOD) Document: A document prepared by Owner, Architect, or Commissioning Authority that records concepts, calculations, decisions, and product selections used to comply with Owner's Project Requirements and to suit applicable regulatory requirements, standards, and guidelines.
- D. Black Site Test (BST): A comprehensive test of the functional performance of the building systems under emergency power. This test is intended to prove correct operation of systems under a complete failure of normal power sources.
- E. Commissioning: A quality-focused process for verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, and tested to comply with Owner's Project Requirements. The requirements specified here are limited to the construction phase commissioning activities.
- F. Commissioning Authority (CxA): An entity engaged by Owner or Architect to lead the Commissioning Process.
- G. Commissioning Plan: A document, prepared by the Commissioning Authority, that outlines the organization, schedule, allocation of resources, and documentation requirements of commissioning. The commissioning plan is not part of the Contract Documents.
- H. Commissioning Portal: A website selected by the CxA to host the commissioning plan, pre-functional checklists, functional performance tests, and the commissioning issues list. The commissioning portal for

this project is "www.CxAlloy.com" and is accessible through standard internet web browsers (Chrome) and mobile devices (iPad).

- I. Commissioning Team: All parties involved in commissioning activities, including but not limited to, the Architect and Engineers (A/E), the Owner, the Commissioning Authority (CxA), and contractors installing systems to be commissioned.
- J. Construction Phase Commissioning Completion: The stage of completion and acceptance of commissioning when resolution of deficient conditions and issues discovered during commissioning and retesting until acceptable results are obtained has been accomplished.
- K. Contract Documents: Documents binding all parties involved in construction of this project (drawings, specifications, change orders, amendments, contracts, etc.).
- L. General Contractor: Contracted directly to Owner
- M. Control System: System and components associated with building automation system.
- N. Functional Performance Test (FPT): A written procedure for the testing of equipment based on the sequence of operation provided by the Engineer of Record and defined in the construction documents. Functional performance tests to be executed by the Contractor at the direction of the CxA.
- O. Issues List: A list of all issues discovered during commissioning.
- P. Monitoring: Recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or trending capabilities of control systems.
- Q. Overridden Value: Writing over a sensor value in control system to see response of a system (e.g., changing outside air temperature value from 52°F to 72°F to verify economizer operation). See also "Simulated Signal"
- R. Owner's Project Requirements: A document written by Owner, Architect, or Commissioning Authority that details the functional requirements of a project and the expectations of how it will be used and operated, including Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- S. Owner's Witness: CxA, Owner's Project Manager, or Architect-designated witness authorized to authenticate test demonstration data and to sign completed test data forms.
- T. Phased Commissioning: Commissioning completed in phases (by floors, for example) due to size of structure or other scheduling issues.
- U. Pre-functional Checklist (PFC): A checklist produced by the CxA and executed by the contractor to verify that appropriate components are onsite, correctly installed, set up, calibrated, functional and ready for functional testing.
- V. Seasonal Testing: Deferred or additional testing to be conducted based on the variance of equipment operation due to seasonal changes in outside air and weather conditions.

- W. Simulated Condition: condition created for testing component or system (e.g., applying heat to space temperature sensor to monitor response of VAV box).
- X. Simulated Signal: Disconnecting sensor and using signal generator to send amperage, resistance or pressure to a transducer and/or DDC system to simulate value to the BAS.
- Y. Site Visit Report: A report produced by the CxA detailing the results of a site visit. Site Visit Reports generally contain a short narrative followed by an attachment of the Issues List.
- Z. Start-up: The activities where systems or equipment are initially tested and operated. Start-up is completed prior to functional testing.
- AA. Sub-contractor: Contractors of CM, and their sub-contractors, who provide and install building components and systems.
- BB. Systems Manual: A document prepared by the CxA based on documentation provided by the A/E team, the installing contractors, and the Commissioning Authority's completed Commissioning Plan. This document is intended to assist the Owner in continued operations and maintenance to the facility after building turnover. Contents include, but are not limited to:
 - 1. A sequence of operations for the building
 - 2. The building occupancy schedule.
 - 3. Equipment run-time schedules.
 - 4. Setpoints for all HVAC equipment.
 - 5. Set lighting levels throughout the commissioned spaces.
 - 6. Minimum outside air requirements.
 - 7. Any changes in schedules or setpoints for different seasons, days of the week, and times of day.
 - 8. A systems narrative describing the mechanical and electrical systems and equipment.
 - 9. A preventive maintenance plan for building equipment described in the systems narrative.
 - 10. A commissioning program that includes periodic commissioning requirements, ongoing commissioning tasks, and continuous tasks for critical facilities.
- CC. "Systems," "Assemblies," "Subsystems," "Equipment," and "Components": Where these terms are used together or separately, they shall mean "as-built" systems, assemblies, subsystems, equipment, and components.
- DD. Test: Performance tests, performance test demonstrations, commissioning tests, and commissioning test demonstrations.
- EE. Trend Data Report: A report produced by the monitoring and logging of setpoints and actual conditions over a period of time with the building automation system.

- FF. Warranty Review: A review of the commissioned equipment lead by the CxA with participation from the commissioning team. This review is conducted approximately 10 months after substantial completion, or two months prior to warranty expiration.

1.5 RELATED DOCUMENTS

- A. Owner's Project Requirements [OPR] and Basis-of-Design [BoD] documentation is included by reference for information only.
- B. The Commissioning Plan
- C. ASHRAE Guideline 0–2005
- D. ASHRAE Guideline 1.1–2007 for HVAC&R systems
- E. 2015 International Energy Conservation Code.
- F. Austin Energy Green Building (AEGB) Commercial Rating Guidebook (2016)

1.6 SUMMARY

- A. The contractor is responsible for the work of this section except where action by the commissioning authority, owner, or Engineer of Record is specifically noted.
- B. This specification is intended to define the Contractor's roles and responsibilities, pertaining to commissioning, in achieving both the Basic Commissioning Requirements and the Additional Commissioning Credit (OPTION 1) found in the AEGB Commercial Rating Guidebook.
- C. The methodologies employed in the commissioning process shall be consistent with those described in ASHRAE Guideline 0-2005 and ASHRAE Guideline 1.1–2007 for HVAC&R systems, and as specified in the AEGB Commercial Rating Guidebook, and the 2015 International Energy Conservation Code.
- D. If a conflict is noted between this 01 9113 Specification and any other portion of the documents, it is incumbent upon the Contractor to request clarification in accordance with project's general conditions.
- E. While the Commissioning Authority may participate in problem solving activities, ultimately responsibilities for design, compliance with all codes, scheduling, construction management, and cost estimating resides with the Contractor.

1.7 RELATED WORK

- A. Additional commissioning requirements may be found in the following sections of these specifications. The following sections apply to Work specified in this section:
 - 1. Basic Fire Suppression System Requirements: Refer to Division 21.
 - 2. Basic Plumbing System Requirements: Refer to Division 22.
 - 3. Basic HVAC System Requirements: Refer to Division 23.

4. Basic Electrical System Requirements: Refer to Division 26.
5. Basic Electrical Safety & Security Requirements: Refer to Division 28.

1.8 COMPENSATION

- A. Should Architect, Engineer, CxA, other Owner's witness, or Owner's staff be required to perform additional services or incur additional expenses due to actions/inactions of Contractor listed below, the Contractor shall compensate the Owner for all related additional services and expenses.
 1. Failure to provide timely notice of commissioning activities schedule changes.
 2. Contractor provides notification of Commissioning testing readiness and after Commissioning team member is on site it is determined that systems to be tested are not ready.
 3. Failure to meet acceptance criteria for test demonstrations.
 4. Failure to provide required commissioning team support including but not limited to; building automation technical support, testing adjusting and balancing (TAB) technical support, inability to access required systems and areas.
 5. Failure to schedule functional testing in a fashion that other onsite activities do not conflict with, hinder, delay, or prevent functional testing.
- B. CxA additional service rate: Contractor shall compensate Owner for such additional services and expenses at the rate of \$200 per labor hour plus \$1000 per round trip for personnel travelling, plus per diem allowances for meals and lodging according to current U.S. General Services Administration (GSA) Per Diem Rates.
- C. Other party additional service rates: As defined in additional services in other party contracts.

1.9 SYSTEMS TO BE COMMISSIONED

- A. The following systems shall be commissioned as part of this project:
 1. Mechanical:
 - a. All new Mechanical/HVAC equipment and associated controls (BAS) within project scope.
 2. Plumbing
 - a. Domestic cold and hot water systems and recirculation within project scope including piping, valving, emergency shut-offs, and fixture operations.
 3. Electrical
 - a. Electrical Distribution Systems
 - b. Emergency Power Systems
 - c. Lighting Controls
 4. Life Safety Systems
 - a. Fire alarm

- b. Sprinkler
- c. Smoke Evacuation
- d. Interfaces between above systems
- 5. Electronic Security Systems
- 6. Irrigation Systems
- 7. Renewable Energy Systems

1.10 COMMISSIONING TEAM

A. Members Appointed CxA/Owner:

- 1. CxA Project Manager and CxA Field Personnel
- 2. Owner's Architect and Engineering design team
- 3. Owner's Project Manager or Representative
- 4. Owner's facility maintenance staff

B. Members Appointed by Contractor:

- 1. Commissioning Coordinator: A person or entity employed by the Contractor to manage, schedule, and coordinate commissioning.
- 2. Project superintendent and other employees that Contractor may deem appropriate for a particular portion of the commissioning.
- 3. Subcontractors, installers, suppliers, and specialists that Contractor may deem appropriate for a particular portion of the commissioning. These team members shall, at a minimum, consist of the mechanical contractor, controls Contractor, TAB contractor, Electrical contractor, Plumbing Contractor, all other contractors installing and performing work on commissioned systems, and any necessary vendor representatives associated with commissioned systems.

C. Appointed team members shall have the authority to act on behalf of the entity they represent

1.11 COMMISSIONING DOCUMENTATION

A. Documentation provided by the Commissioning Authority

- 1. Commissioning Plan (Cx Plan)
 - a. The Cx Plan will be assembled by the CxA.
 - b. Cx Plan includes, at minimum:
 - 1) Narrative: A document describing the activities that will be accomplished during each phase of commissioning, including the personnel intended to accomplish each of the activities.

- 2) Equipment List: A listing of the specific equipment, appliances or systems subject to commissioning requirements and a listing of the checks and/or tests to be performed,
 - 3) Pre-functional Checklists (PFCs): Project specific checklists, referencing contract document requirements. PFC's are created by the CxA to be completed on the project by the installing contractor for all commissioned systems. PFCs are not start-up forms and do not serve as replacements to start-up documentation.
 - 4) Functional Performance Tests (FPTs): Tests which are created by the CxA designed to test the modes of each piece of equipment/system. These shall be created based on all modes indicated in the Sequences of Operation (SOO) provided within the Construction Documents (not controls submittals). They shall also fully document pertinent setpoints and actual readings quantitatively per building automation system reporting.
 - 5) Sample Issues List: A sample document illustrating the display format of documenting issues discovered during the commissioning process.
 - 6) Proposed deliverables schedule.
- c. The Cx Plan will be provided in PDF format to the Commissioning Team by the CxA
 - d. The Cx Plan will reside on a server accessible through the Commissioning Portal (www.CxAlloy.com). The CxA will provide members of the Commissioning Team login credentials.
- B. Documentation provided to the CxA by the Contractor
1. Submittals
 - a. Submittals shall be provided to CxA for all equipment and systems to be commissioned.
 - b. Provide to CxA concurrently with submission to Engineer of Record.
 2. Commissioning Plan Information:
 - a. Commissioning Coordinator shall provide listing of contractor-appointed Commissioning Team members to CxA to be assigned execution duties of PFC's. Contractor-appointed team members must be capable of interfacing with the Commissioning Portal.
 - b. Provide at least one team member for each subcontractor installing systems/equipment to be commissioned.
 - 1) Information listing for contractor-appointed team members shall include:
 - a) First and Last Name
 - b) Role
 - c) Email address to be used for login credentials to web application
 - d) Company
 - c. Coordinate with the commissioning team to provide schedule of commissioning activities integrated with the construction schedule.

- d. Provide all required commissioning plan information no more than 5 days after the Cx Kick-off Meeting.
3. PFCs:
- a. If CxA has authorized Contractor to complete PFC's in paper format or any other method in lieu of completing them through the Commissioning Portal, contractor shall submit completed PFCs to CxA for review. Contractor shall execute PFCs on the commissioning portal (CxAlloy.com) unless written permission to execute on paper is provided by CxA.
 - b. Keep status of Equipment and PFCs updated on CxAlloy Server under "Equipment Status" parameter and "PFC Status" parameter.
 - c. Complete and submit all PFC's provided in the Cx Plan to CxA.
 - d. Complete PFCs on CxAlloy server or submit paper copies to CxA prior to commencement of functional performance testing.
 - e. Sampling strategies are not acceptable.
 - f. Complete PFCs prior to commencement of functional performance testing.
4. Start-up Plan
- 1) Start-up plan shall be provided to CxA for all equipment to be commissioned.
 - 2) Submit completed manufacturer's start-up plan for each piece of equipment for which the respective manufacturer provides such form.
 - 3) Submit completed alternative start-up plan for each piece of equipment requiring start-up for which no manufacturer's start-up form exists.
- b. Submit completed start-up plan to CxA for review prior to commencement of functional performance testing.
 - c. PFC's shall not be used to replace or in lieu of start-up plan.
5. Trend Data Reports
- a. Provide trend data reports of points and at intervals as listed in the EOR sequences of operation.
 - b. Organize and group data points in reports by equipment as listed in the EOR's sequences of operation.
 - c. If the sequences of operation do not indicate points to be trended, provide trend data report for each point shown on the controls schematics that shall be reported to the Building Automation System.
 - d. If the sequence of operation does not indicate trend intervals, provide all points at equal and corresponding intervals of 5 minutes.
 - e. Duration of trend data for all points shall be no less than 7 consecutive days.

- f. Provide trend data reports to CxA in “.CSV” or “.XLSX” format or any other format which the CxA approves.
 - g. Provide sample submission illustrating the organization and format of the trend data to CxA for approval prior to trend data report submission.
 - h. Provide initial trend data reports to CxA no less than 2 weeks prior to scheduled functional testing for respective equipment.
 - i. Provide opposed season trend data reports for all equipment scheduled for opposed season testing in the same manner as required for the initial trend data reports with the following change:
 - 1) Contractor shall utilize a start date and time, for opposed season trend data reports, that is provided by the CxA. Contractor is responsible for requesting, in written form, the start date and time from the CxA no more than 90 days after the issuing of the Certificate of Occupancy.
6. Testing Readiness
- a. Submit “testing readiness” correspondence to CxA via email for each scheduled functional testing period no less than 3 business days prior to start date of the functional testing.
 - b. Testing readiness correspondence, for each system and piece of equipment to be tested during the respective functional testing period, shall include:
 - 1) Verification by the contractor that:
 - a) The equipment/system scheduled to be tested is complete and ready to test.
 - b) The equipment/system is communicating with the Building Automation System.
 - c) Building Automation System front end graphics are complete and will be available to be viewed in real time at the scheduled testing date.
 - d) Required contractor personnel are available for the duration and uninterrupted.
 - e) Scheduled functional testing will not be prevented, delayed, or hindered by other onsite activities such as, but not limited to, fire alarm testing, emergency power testing, and re-allocation of scheduled controls personnel.
 - 2) Any exceptions to scheduled testing.
7. Issues List Response
- a. If CxA has authorized Contractor to update the Issues List in paper format or any other method in lieu of responding through the Commissioning Portal, contractor shall submit “Issues List Response” response to CxA no later than one week after each issuance of a site visit report by the CxA. Contractor shall update Issues List responses on the commissioning portal (CxAlloy.com) unless CxA provides written permission to provide responses through other methods.

8. Systems Manual Data
 - a. Provide the following documentation for all commissioned equipment for inclusion into Systems Manual:
 - 1) "OPERATION AND MAINTENANCE DATA"
 - 2) "FINAL SEQUENCE OF OPERATION"
 - 3) "FINAL TEST, ADJUST, AND BALANCE(TAB) REPORT"
 - 4) "EQUIPMENT SETPOINTS"
 - 5) "EQUIPMENT SCHEDULES": Run-time schedules.
 - 6) "OCCUPANCY SCHEDULE": The final space occupancy schedule for all spaces in the project.
 - 7) "LIGHTING LEVELS": Set lighting levels throughout the commissioned spaces.
 - 8) "MINIMUM OUTSIDE AIR REQUIREMENTS"
 - 9) "EXCEPTIONS TO SCHEDULES AND SETPOINTS": Any changes in schedules or setpoints for different seasons, days of the week, and times of day.
 - 10) "MAINTENANCE SCHEDULE": Complete listing of preventative maintenance activities and associated frequencies for all commissioned equipment.
 - 11) "CONTRACTOR CONTACT INFORMATION" Complete listing of installing contractors categorized by systems for each system being commissioned.
 - b. Provide Systems Manual Data in "text searchable" PDF or other format approved by CxA.
 - c. Provide Systems Manual Data categorized in sections indicated above and labeled as such.
 - d. Provide Systems Manual Data to CxA no later than 90 days of the issuance for the certificate of occupancy.

1.12 QUALITY ASSURANCE

- A. Commissioning Coordinator Qualifications:
 1. Documented experience commissioning systems of similar complexity to those contained in these documents on at least 3 projects of similar scope and complexity.
 2. Capable of interfacing with the Commissioning Portal. Such operations include but are not limited to:
 - a. Adding Contractor personnel to commissioning portal (CxAlloy).
 - b. Responding to issues via web portal.
 - c. Tracking sub-contractors' progress in proper completion of checklists.
 - d. Executing tasks generated in the web application.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Test equipment and instrumentation required to perform the commissioning shall remain the property of Contractor unless otherwise indicated.
- B. Test equipment and instrumentation required to perform commissioning shall comply with the following criteria:
 - 1. Be manufactured for the purpose of testing and measuring tests for which they are being used and have an accuracy to test and measure system performance within the tolerances required to determine acceptable performance.
 - 2. Calibrated and certified.
 - a. Calibration performed and documented by a qualified calibration agency according to national standards applicable to the tools and instrumentation being calibrated. Calibration shall be current according to national standards or within test equipment and instrumentation manufacturer's recommended intervals, whichever is more frequent, but not less than within six months of initial use on Project. Calibration tags permanently affixed.
 - b. Repair and recalibrate test equipment and instrumentation if dismantled, dropped, or damaged since last calibrated.
 - 3. Maintain test equipment and instrumentation.
 - 4. Use test equipment and instrumentation only for testing or monitoring Work for which they are designed.

2.2 PROPRIETARY TEST EQUIPMENT, INSTRUMENTATION, AND TOOLS

- A. Proprietary test equipment, instrumentation, and tools are those manufactured or prescribed by tested equipment manufacturer and required for work on its equipment as a condition of equipment warranty, or as otherwise required to service, repair, adjust, calibrate, or perform work on its equipment.
 - 1. Identify proprietary test equipment, instrumentation, and tools required in the test equipment identification list submittal.
 - 2. Proprietary test equipment, instrumentation, and tools shall become the property of Owner at Substantial Completion.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review Cx Plan for accuracy and completeness.
- B. Document any exceptions to checklists and functional performance test criteria. Examples of exceptions include, but are not limited to:

1. Pre-fabricated kits or assemblies which do not correspond to details, specifications, or other the requirements of the contract documents, but have been approved by the Engineer of Record. Examples of such items include, but are not limited to:
 - a. Hydronic hose kits
 - b. Insulating, piping, and labeling of equipment
 - c. Prefabricated skid-mounted assemblies
 - d. Factory installed provisions for which the contract documents depict field installation.
2. Functional testing methods or sequences which cannot be used on the project or must be altered to depict correct function.

3.2 COMMISSIONING KICK-OFF MEETING

- A. Commissioning Coordinator shall schedule and host a commissioning kickoff meeting to be held on site directly prior to or after a regularly scheduled Owner/Architect/Contractor (OAC) meeting.
- B. Kickoff meeting shall be conducted prior to equipment and systems installation for commissioned systems.
- C. The commissioning coordinator shall contact the CxA for approval of meeting time no less than three weeks prior to the selected date.
- D. The following entities shall be invited to the meeting by the commissioning coordinator:
 1. Mandatory attendees:
 - a. Commissioning Authority
 - b. Commissioning coordinator
 - c. Controls contractor
 - d. Sub-contractors involved in the installation of commissioned systems and equipment.
 2. Other invitees:
 - a. Owner's representative
 - b. Architect
 - c. Engineer of Record
 - d. Testing, Adjusting, and Balancing Contractor
 - e. Any other commissioning team members appointed by the contractor, CxA, or Owner.
- E. CxA reserves the right to conduct the Commissioning kickoff meeting from a remote location. In such case, contractor must supply a proper electronic communications platform to provide sufficient audio and visual display for the onsite team to communicate with the CxA both visually and verbally. The communication platform shall be capable of logging into and joining a Microsoft Teams meeting invitation provided by the CxA. Commissioning coordinator is responsible for logging into meeting for onsite attendees.

3.3 OTHER MEETINGS

- A. Contractor shall notify CxA of any requested CxA involvement in meetings not specifically scheduled for commissioning activities. Contractor shall notify CxA of such requests no less than three days prior to each meeting and provide call-in information to the CxA in the instance that the CxA is unable to attend onsite.

3.4 PRE-FUNCTIONAL CHECKLISTS (PFCs)

- A. PFCs cannot modify or conflict with the Contract Documents.
- B. PFCs are provided by the CxA and are accessible to commissioning team members through the Commissioning Portal.
- C. PFCs are based on actual systems and equipment to be included in the Project. Requirements in the checklists reference the construction documents when applicable.
- D. Contractor shall execute the following tasks associated with PFCs:
 - 1. Execute PFCs on the Commissioning Portal.
 - 2. Photograph and upload high resolution digital photographs that clearly represent the requested picture to the PFC's where prompted.
 - 3. Contractor shall ensure that PFC completion is accurate and up to date with construction progress to within two weeks.
 - 4. Contractor shall note any conflicts between PFC requirements and construction conditions as issues to be tracked in the web application.
- E. The PFC for each piece of equipment must be completed prior to functionally testing the equipment.
- F. Contractor shall maintain the "PFC Status" parameter within two weeks up being current for each PFC in CxAlloy

3.5 TEST, ADJUST, AND BALANCE (TAB) REVIEW AND SAMPLING

- A. Provide preliminary TAB report to CxA for review no less than two weeks before scheduled TAB report sampling by CxA.
- B. Commissioning coordinator shall coordinate with CxA to schedule TAB report sampling. TAB sampling duration shall not exceed 20% of measurements. CxA reserves the right to require further contractor cooperation if any of the following conditions occur:
 - 1. Greater than 10% of sampled TAB readings are not within the allowable tolerances of TAB specifications.
- C. Contractor shall provide same TAB personnel and testing equipment to sample the TAB report as conducted the initial TAB activities.

3.6 FUNCTIONAL PERFORMANCE TESTS

- A. Functional Performance Tests cannot modify or conflict with the contract documents.
- B. Functional performance tests are provided by the CxA and are accessible to commissioning team members through the Commissioning Portal.
- C. Functional performance tests are written by the CxA and based on the sequences of operation available within the construction documents. The tests are not based on the approved controls submittals.
- D. Notify CxA of known controls conflicts between approved submittals and the sequence of operation within the construction documents prior to the scheduling of functional performance tests.
- E. Conduct functional tests at the direction of the CxA, who will document and verify functional testing results.
- F. Provide all personnel, materials, and equipment deemed necessary by the CxA for testing all commissioned systems and equipment. Such provisions include, but are not limited to:
 - 1. Qualified controls personnel: Controls technician shall have no less than five years of experience in programming and installing building automation system controls. Controls technician shall be familiar with and have participated in the controls programming for the systems being tested **at this project site.**
 - 2. Calibrated testing equipment.
 - 3. Ladders and other equipment necessary to access commissioned equipment.
 - 4. Personnel to demonstrate fire damper function to CxA and reset fire damper linkages to proper setting after testing.
 - 5. Test, Adjust, and Balancing personnel to verify air and water flow readings during testing.
 - 6. Factory authorized start-up and controls personnel for stand-alone controls which are not fully integrated into the building automation system. Examples of such systems may include:
 - a. Hot Water Boiler controls
 - b. Dedicated Outside Air Unit Controls
 - c. Manufacturer provided standard air handling unit controls.
- G. Contractor shall continue to provide personnel and resources to assist the CxA until all issues on the Issues List have been resolved.
- H. Schedule all functional performance testing with subcontractors and CxA. Proposed test dates shall not conflict with scheduled fire alarm testing, emergency power testing, or other activities that would delay or interrupt functional testing of commissioned systems.
- I. Provide no less than two weeks of notice of intent to test equipment for each proposed testing date.

- J. Functional testing of each piece of equipment shall not be commenced prior to the contractors submission of Trend Data Reports to the CxA for that equipment.
- K. Deferred Testing: During deferred testing, contractor shall provide CxA access to and usage of all provisions utilized during the original functional performance testing period.

3.7 COMMISSIONING ISSUES LIST

- A. Provide responses to all issues not assigned to other members of the Commissioning Team on the Commissioning Portal within one week of their posting on the Commissioning Portal. Responses shall be provided directly on the Commissioning Portal.
- B. For all issues for which the solution can be visually verified, contractor shall provide a high resolution digital photograph clearly depicting the issue resolution as an attachment in the issue response.
- C. Notify CxA in writing when all contractor-related issues have been resolved on the web portal.

3.8 COMMISSIONING TRAINING REQUIREMENTS

- A. Provide all training in accordance with specifications. If requirements in this specification conflict with training requirements indicated elsewhere in the construction documents, those requirements supersede the requirements listed in this section. Note this exception does not apply to conditions where this specification is an augmentation to other training requirements.
- B. Provide all training material to CxA prior to training activities.
- C. Unless specifications otherwise require training to be recorded in video format, all training for commissioned equipment and systems shall be provided as such:
 - 1. Notify CxA of all training and demonstrations of commissioned systems at least one week in advance
 - 2. Record with high resolution video and save as MP4, AVI, WMV, or other format approved by CxA.
 - 3. Any vocal descriptions provided in the training must be audible and distinguishable from ambient noise. This may require the Contractor to furnish a microphone to interface with video recording equipment while in equipment rooms or other areas with high volumes of ambient noise. CxA reserves to right to reject training videos which he deems inaudible and require Contractor to re-submit a version with clear audio.
 - 4. At the introduction of the training for each system, identify the manufacturer of the system as well as at least one service company qualified to provide maintenance and repair work on the associated equipment and systems.
 - 5. At conclusion of training, provide to CxA an Audio/Video recording of all training sessions in a digital format approved by the CxA.

3.9 CERTIFICATE OF CONSTRUCTION PHASE COMMISSIONING COMPLETION

- A. When Contractor considers that construction phase commissioning, or a portion thereof which Owner agrees to accept separately, is complete, Contractor shall prepare and submit to Owner and

Commissioning Authority, utilizing established standard submittal process as outlined in these documents, a comprehensive list of items to be completed or corrected. Failure to include an item on such list does not alter Contractor's responsibility to complete commissioning.

- B. Contractor shall promptly correct deficient conditions and issues discovered during commissioning. Costs of correcting such deficient conditions and issues, including additional testing and inspections, the cost of uncovering and replacement, and compensation for Architect's and Commissioning Authority's services and expenses made necessary thereby, shall be at Contractor's expense. Contractor shall document, via photograph when possible, all resolutions associated with commissioning issues.

3.10 COMMISSIONING WARRANTY REQUIREMENTS

- A. Provide to CxA all warranty materials within 90 days of issuing of certificate of occupancy.
- B. Commissioning Coordinator shall schedule and host a Warranty Review meeting to be held on site two months prior to the warranty period expiration. All members of the commissioning team shall be invited.
- C. Provide personnel to aide CxA in accessing commissioned equipment directly prior to the warranty review meeting.
- D. Warranty review meeting shall be scheduled no less than four weeks in advance of the proposed meeting date.

3.11 OPPOSED SEASON TESTING

- A. Contractor shall schedule and conduct, at the direction of the CxA, opposed season or "deferred" testing, as directed by the CxA, during no more than 8 months after initial functional testing dates.
- B. Contractor shall re-submit trend data reports according to requirements outlined in the "**TREND DATA REPORTS**" portion of this specification.
- C. Commissioning Coordinator shall submit the proposed opposed season testing date to CxA for approval no less than three weeks prior to the proposed testing date.
- D. Contractor shall provide to CxA, for the duration of opposed season testing, all provisions indicated in the "**FUNCTIONAL PERFORMANCE TEST**" section of this specification.

END OF SECTION

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SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Pier caps.
 - 2. Plinths and grade beams:
 - 3. Slabs-on-grade.
 - 4. Spread footings.
 - 5. Walls.
 - 6. Elevated slabs and beams.
 - 7. Slabs on steel deck.
 - 8. Concrete topping slabs.
- B. Related Sections:
 - 1. Division 3 Section "Architectural Concrete" for general building applications of specially finished formed concrete.
 - 2. Division 3 Section "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.
 - 3. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
 - 4. Division 32 Section "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, metakaolin, and other pozzolans, slag cement and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS FOR REVIEW

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.

2. Where LEED MR credits are pursued, include zero percent fly ash mixtures as a baseline mix design for each concrete mix strength indicated to have fly ash replacement.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and reshoring installation and removal.
- E. Control Joint and Construction Joint Layout: Indicate proposed control joints and construction joints required to construct the structure.
 1. Location of control joints and construction joints is subject to approval of the Architect and Engineer.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, manufacturer, testing agency.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 1. Cementitious materials.
 2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Waterstops.
 6. Curing compounds.
 7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Vapor retarders.
 11. Semirigid joint filler.
 12. Joint-filler strips.
 13. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.

- G. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- H. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

- G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Other than those specified in the following paragraphs, form ties encased in concrete shall be designed so that, after removal, no corrodible metal will remain closer than 1-1/2 inches to the plane of exposed concrete surface. The part of the tie to be removed shall be at least 1/2 inch diameter or be provided with a wood or metal cone at least 1/2 inch diameter and 1-1/2 inches long. Form ties in concrete exposed to view shall be the cone-washer type.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Form ties for exposed exterior and interior walls shall be as specified in the preceding paragraph except that the cones shall be of approved wood or plastic.
 - 4. Flat bar ties for panel forms shall have plastic or rubber inserts having a minimum depth of 1-1/2-in and sufficient dimensions to permit proper patching of the tie hole.
 - 5. Ties for liquid containment structures shall have an integral waterstop that is tightly welded to the tie.
 - 6. Common wire shall not be used for form ties.

2.2 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Domestic Steel: All steel shall be domestically manufactured, unless foreign sources are specifically accepted by the Owner.
- C. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- D. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M for all welded reinforcement, deformed.
- E. Plain-Steel Wire: ASTM A 82/A 82M, as drawn unless otherwise noted.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

- C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 Mechanical Splices

- A. Provide mechanical splices to develop, in tension and compression, 125 percent of the minimum ASTM specified yield strength of the smaller bar being spliced. The following splicing systems are acceptable:

1. Lenton "Taper-threaded Splice"
2. Lenton "Cadweld"
3. Dayton Barsplice "BarGrip XL"
4. Dayton Barsplice "Grip-Twist"

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - 1) Class C fly ash is an acceptable alternative if concrete supplier provides certificate stating fly ash will not cause alkali-silica reaction with the aggregate.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

- B. Silica Fume: ASTM C 1240, amorphous silica.

- C. Normal-Weight Aggregates: ASTM C 33, Class 1N coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years of satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

- D. Water: ASTM C 94/C 94M and potable.

2.6 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
 - b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.
 - c. Euclid Chemical Company (The), an RPM company; EUCON CIA.
 - d. Grace Construction Products, W. R. Grace & Co.; DCI.
 - e. Sika Corporation; Sika CNI.
- D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
 - b. Cortec Corporation; MCI- 2000.
 - c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
 - d. Sika Corporation; FerroGard 901.
- E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ChemMasters.
 - b. Davis Colors.
 - c. Dayton Superior Corporation.
 - d. Hoover Color Corporation.
 - e. Lambert Corporation.

- f. QC Construction Products.
- g. Rockwood Pigments NA, Inc.
- h. Scofield, L. M. Company.
- i. Solomon Colors, Inc.

2. Color: As selected by Architect from manufacturer's full range.

2.7 WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Greenstreak.
- b. Vinylex Corp.

2. Profile: Ribbed with center bulb
3. Dimensions: 6 inches by 3/8 inch thick; nontapered.

- B. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Adeka Ultra Seal/OCM, Inc.; Adeka Ultra Seal.
- b. Greenstreak; Hydrotite.
- c. Vinylex Corp.; Swellseal.

2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder: Include manufacturer's recommended adhesive or pressure-sensitive tape to address seams, penetration repairs, and perimeter/edge seals. When the specifications or drawings conflict, the contractor shall perform to the most restrictive provision.

1. Vapor retarder membrane must have the following properties:

- a. Permeance as tested after mandatory conditioning (ASTM E 154 sections 8, 11, 12, 13) less than 0.02 Perms [grains/(ft²*hr*in.Hg)].
- b. Other performance criteria:
 - 1) Strength: ASTM E 1745, Class A
 - 2) Thickness: 15 mils minimum

2. Subject to compliance with requirements above, provide one of the following:

- a. Stego Industries, LLC; Stego Wrap 15 mil Class A.
- b. Meadows, W. R., Inc.; Perminator 15 mil.

- c. Fortifiber Building Systems Group; Moistop Ultra 15 mil.
- d. No substitutions.

2.9 FLOOR AND SLAB TREATMENTS

- A. Slip-Resistive Emery Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive, crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials with 100 percent passing No. 8 sieve.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; Emery.
 - b. Dayton Superior Corporation; Emery Tuff Non-Slip.
 - c. Lambert Corporation; EMAG-20.
 - d. L&M Construction Chemicals, Inc.; Grip It.
 - e. Metalcrete Industries; Metco Anti-Skid Aggregate.
- B. Slip-Resistive Aluminum Granule Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of not less than 95 percent fused aluminum-oxide granules.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; A-H Alox.
 - b. BASF Construction Chemicals - Building Systems; Frictex NS.
 - c. L&M Construction Chemicals, Inc.; Grip It AO.
- C. Emery Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded emery aggregate, and plasticizing admixture; with emery aggregate consisting of no less than 60 percent of total aggregate content.
 1. Color: selected by Architect from manufacturer's full range.
- D. Metallic Dry-Shake Floor Hardener: Unpigmented, factory-packaged, dry combination of portland cement, graded metallic aggregate, rust inhibitors, and plasticizing admixture; with metallic aggregate consisting of no less than 65 percent of total aggregate content.
 1. Color: As selected by Architect from manufacturer's full range.
- E. Unpigmented Mineral Dry-Shake Floor Hardener: Factory-packaged dry combination of portland cement, graded quartz aggregate, and plasticizing admixture.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Maximent.
 - b. ChemMasters; ConColor.
 - c. Conspec by Dayton Superior; Conshake 500.
 - d. Dayton Superior Corporation; Quartz Tuff.
 - e. Edoco by Dayton Superior; Burke Non Metallic Floor Hardener 250.

- f. Euclid Chemical Company (The), an RPM company; Surfex.
 - g. Kaufman Products, Inc.; Tycron.
 - h. Lambert Corporation; Colorhard.
 - i. L&M Construction Chemicals, Inc.; Quartzplate FF.
 - j. Metalcrete Industries; Floor Quartz.
 - k. Scofield, L. M. Company; Lithochrome Color Hardener.
 - l. Symons by Dayton Superior; Hard Top.
- F. Pigmented Mineral Dry-Shake Floor Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.
- 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Mastercron.
 - b. ChemMasters; ConColor.
 - c. Conspec by Dayton Superior; Conshake 600 Colortone.
 - d. Dayton Superior Corporation; Quartz Tuff.
 - e. Edoco by Dayton Superior; Burke Non Metallic Floor Hardener 200 - 205.
 - f. Euclid Chemical Company (The), an RPM company; Surfex.
 - g. Kaufman Products, Inc.; Tycron.
 - h. Lambert Corporation; Colorhard.
 - i. L&M Construction Chemicals, Inc.; Quartz Plate FF.
 - j. Metalcrete Industries; Floor Quartz.
 - k. Scofield, L. M. Company; Lithochrome Color Hardener.
 - l. Symons by Dayton Superior; Color Hardener.
 - 2. Color: As selected by Architect from manufacturer's full range.

2.10 LIQUID FLOOR TREATMENTS

- A. VOC Content: Liquid floor treatments shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ChemMasters; Chemisil Plus.
 - b. ChemTec Int'l; ChemTec One.
 - c. Conspec by Dayton Superior; Intraseal.
 - d. Curecrete Distribution Inc.; Ashford Formula.
 - e. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
 - f. Edoco by Dayton Superior; Titan Hard.
 - g. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
 - h. Kaufman Products, Inc.; SureHard.
 - i. L&M Construction Chemicals, Inc.; Seal Hard.
 - j. Meadows, W. R., Inc.; LIQUI-HARD.

- k. Metalcrete Industries; Floorsaver.
 - l. Nox-Crete Products Group; Duro-Nox.
 - m. Symons by Dayton Superior; Buff Hard.
 - n. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.
 - o. Vexcon Chemicals, Inc.; Vexcon StarSeal PS Clear.
- C. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Advanced Floor Products; Retro-Plate 99.
 - b. L&M Construction Chemicals, Inc.; FGS Hardener Plus.
 - c. QuestMark, a division of CentiMark Corporation; DiamondQuest Densifying Impregnator Application.

2.11 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
 - b. BASF Construction Chemicals - Building Systems; Confilm.
 - c. ChemMasters; SprayFilm.
 - d. Conspec by Dayton Superior; Aquafilm.
 - e. Dayton Superior Corporation; Sure Film (J-74).
 - f. Edoco by Dayton Superior; BurkeFilm.
 - g. Euclid Chemical Company (The), an RPM company; Eucobar.
 - h. Kaufman Products, Inc.; Vapor-Aid.
 - i. Lambert Corporation; LAMBCO Skin.
 - j. L&M Construction Chemicals, Inc.; E-CON.
 - k. Meadows, W. R., Inc.; EVAPRE.
 - l. Metalcrete Industries; Waterhold.
 - m. Nox-Crete Products Group; MONOFILM.
 - n. Sika Corporation; SikaFilm.
 - o. SpecChem, LLC; Spec Film.
 - p. Symons by Dayton Superior; Finishing Aid.
 - q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
 - r. Unitex; PRO-FILM.
 - s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
 - b. BASF Construction Chemicals - Building Systems; Kure 200.
 - c. ChemMasters; Safe-Cure Clear.
 - d. Conspec by Dayton Superior; W.B. Resin Cure.
 - e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
 - f. Edoco by Dayton Superior; Res X Cure WB.
 - g. Euclid Chemical Company (The), an RPM company; Kurez DR VOX; TAMMSCURE WB 30C.
 - h. Kaufman Products, Inc.; Thinfilm 420.
 - i. Lambert Corporation; AQUA KURE - CLEAR.
 - j. L&M Construction Chemicals, Inc.; L&M Cure R.
 - k. Meadows, W. R., Inc.; 1100-CLEAR.
 - l. Nox-Crete Products Group; Resin Cure E.
 - m. Right Pointe; Clear Water Resin.
 - n. SpecChem, LLC; Spec Rez Clear.
 - o. Symons by Dayton Superior; Resi-Chem Clear.
 - p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
 - q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.
- F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anti-Hydro International, Inc.; AH Clear Cure WB.
 - b. BASF Construction Chemicals - Building Systems; Kure-N-Seal WB.
 - c. ChemMasters; Safe-Cure & Seal 20.
 - d. Conspec by Dayton Superior; Cure and Seal WB.
 - e. Cresset Chemical Company; Crete-Trete 309-VOC Cure & Seal.
 - f. Dayton Superior Corporation; Safe Cure and Seal (J-18).
 - g. Edoco by Dayton Superior; Spartan Cote WB II.
 - h. Euclid Chemical Company (The), an RPM company; Aqua Cure VOX; Clearseal WB 150.
 - i. Kaufman Products, Inc.; Cure & Seal 309 Emulsion.
 - j. Lambert Corporation; Glazecote Sealer-20.
 - k. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - l. Meadows, W. R., Inc.; Vocomp-20.
 - m. Metalcrete Industries; Metcure.
 - n. Nox-Crete Products Group; Cure & Seal 150E.
 - o. Symons by Dayton Superior; Cure & Seal 18 Percent E.
 - p. TK Products, Division of Sierra Corporation; TK-2519 WB.
 - q. Vexcon Chemicals, Inc.; Starseal 309.
- G. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal W.
 - b. ChemMasters; Safe-Cure Clear.
 - c. Conspec by Dayton Superior; High Seal.
 - d. Dayton Superior Corporation; Safe Cure and Seal (J-19).
 - e. Edoco by Dayton Superior; Spartan Cote WB II 20 Percent.
 - f. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
 - g. Kaufman Products, Inc.; SureCure Emulsion.
 - h. Lambert Corporation; Glazecote Sealer-20.
 - i. L&M Construction Chemicals, Inc.; Dress & Seal WB.
 - j. Meadows, W. R., Inc.; Vocomp-20.
 - k. Metalcrete Industries; Metcure 0800.
 - l. Nox-Crete Products Group; Cure & Seal 200E.
 - m. Symons by Dayton Superior; Cure & Seal 18 Percent E.
 - n. Vexcon Chemicals, Inc.; Starseal 0800.

- H. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure-N-Seal 25 LV.
 - b. ChemMasters; Spray-Cure & Seal Plus.
 - c. Conspec by Dayton Superior; Sealcure 1315.
 - d. Dayton Superior Corporation; Day-Chem Cure and Seal (J-22UV).
 - e. Edoco by Dayton Superior; Cureseal 1315.
 - f. Euclid Chemical Company (The), an RPM company; Super Diamond Clear; LusterSeal 300.
 - g. Kaufman Products, Inc.; Sure Cure 25.
 - h. Lambert Corporation; UV Super Seal.
 - i. L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - j. Meadows, W. R., Inc.; CS-309/30.
 - k. Metalcrete Industries; Seal N Kure 30.
 - l. Right Pointe; Right Sheen 30.
 - m. Vexcon Chemicals, Inc.; Certi-Vex AC 1315.
 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- I. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. BASF Construction Chemicals - Building Systems; Kure 1315.
 - b. ChemMasters; Polyseal WB.
 - c. Conspec by Dayton Superior; Sealcure 1315 WB.
 - d. Edoco by Dayton Superior; Cureseal 1315 WB.
 - e. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.

- f. Kaufman Products, Inc.; Sure Cure 25 Emulsion.
- g. Lambert Corporation; UV Safe Seal.
- h. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
- i. Meadows, W. R., Inc.; Vocomp-30.
- j. Metalcrete Industries; Metcure 30.
- k. Right Pointe; Right Sheen WB30.
- l. Symons by Dayton Superior; Cure & Seal 31 Percent E.
- m. Vexcon Chemicals, Inc.; Vexcon Starseal 1315.

- 2. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.12 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- E. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.14 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- A. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 1. Fly Ash:
 - a. Piers: 40 percent.
 - b. Architecturally exposed concrete slabs: 10 percent
 - c. All concrete other than piers and architecturally exposed concrete slabs: 25 percent
 2. Combined Fly Ash and Pozzolan: 25 percent for all mixes except piers; 40 percent for piers.
 3. Ground Granulated Blast-Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent at all mixes except for piers, which shall not exceed 40 percent.
 5. Silica Fume: 10 percent.
 6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent for all mixes except piers; 50 percent with fly ash or pozzolans not exceeding 40 percent for piers; and silica fume not exceeding 10 percent for all mixes.
 7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent for all mixes except piers; 75 percent with fly ash or pozzolans not exceeding 40 percent for piers; silica fume not exceeding 10 percent for all mixes.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.

2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
- D. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.15 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Pier Caps, Plinths, Grade Beams, Slabs on Grade, Spread Footings, Walls, Elevated Slabs and Beams, Concrete on Metal Deck, and Topping Slabs: Proportion normal-weight concrete mixture as follows:
1. Minimum 28-day Compressive Strength: As indicated.
 2. Slump Limit: As indicated.
 3. Maximum Water-Cementitious Materials Ratio: As indicated.
 4. Air Content: As indicated.
 5. Maximum Aggregate Size: As indicated.

2.16 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.17 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete unless noted otherwise in Drawings.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 - 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 3. Install dovetail anchor slots in concrete structures as indicated.

3.3 VOID FORMS

- A. Install void forms in all locations shown on the Drawings. In general, void forms shall be placed below all structural elements supported by piers to separate these elements from the earth.
- B. Seal discontinuous ends of void forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between void form sections.
- C. Premanufactured void forms with circular edges shall be used around all drilled piers.
- D. Do not allow any portion of void forms to fall within the circumference of piers causing a reduction in the bearing area.
- E. Protect void forms from water. Do not install void forms during wet weather or on wet ground. Void forms which become saturated prior to placement of concrete shall be removed and replaced.
- F. Exercise care in placement of concrete to avoid collapse of void form. If void forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created by installing soil retainers.
- G. Void forms under slabs shall be protected by a layer of one-eighth inch thick protection board followed by a vapor barrier or retarder per the specifications. Do not install void forms under soil supported slabs on grade.

3.4 SOIL RETAINERS

- A. Install soil retainers in straight, clean trenches at sides of void forms prior to concrete placement. The gaps between the trench and retainers must be properly positioned or backfilled prior to the placement of concrete. Do not cast the sides of concrete beams directly against the soil.
- B. Affix the soil retainers to the concrete beam with adhesive, pin/washer/load, or concrete hard nails spaced on 24 inch centers.

3.5 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
 2. Formwork supporting conventionally reinforced concrete shall not be removed until concrete has attained 75 percent of its specified 28 day compressive strength as established by tests of field cured cylinders. In the absence of cylinder tests, supporting formwork shall remain in place until the concrete has cured at a temperature of at least 50 degrees Fahrenheit for the minimum cumulative time periods given in ACI 347, Section 3.7.2.3. When the surrounding air temperature is below 50 degrees Fahrenheit, that time period shall be added to the minimum listed time period. Formwork for two-way conventionally reinforced slabs shall remain in place for at least the minimum cumulative time periods specified for one-way slabs of the same maximum span.
 3. Minimum cumulative curing times may be reduced by the use of high-early strength cement or forming systems which allow form removal without disturbing shores, but only after the Contractor has demonstrated to the satisfaction of the Architect that the early removal of forms will not cause excessive sag, distortion or damage to the concrete elements.
 4. Wood forms shall be completely removed. Provide temporary openings if required.
 5. Provide adequate methods of curing and thermal protection of exposed concrete if forms are removed prior to completion of specified curing time.
 6. Areas required to support construction loads in excess of 20 psf shall be reshored to properly distribute construction loading. Construction loads up to the rated live load capacity may be placed on unshored construction provided the concrete has attained the specified 28 day compressive strength.
 7. Obtaining concrete compressive strength tests for the purposes of form removal shall be the responsibility of the Contractor.
 8. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.6 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

3.7 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
1. Unroll vapor retarder with the longest dimension parallel with the direction of the concrete placement and face laps away from the expected direction of the placement whenever possible.
 2. Extend vapor retarder over footings and grade beams to a distance acceptable to the structural engineer or stop at impediments such as dowels and waterstops.
 3. Seal vapor retarder to slab perimeter/edge using manufacturer's recommended tape and remove dirt, debris, and mud from tape prior to concrete placement OR seal vapor retarder to footing/grade beam with double sided tape, termination bar, or both.
 4. Overlap all joints 6 inches and seal with manufacturer's tape.
 5. Apply tape to clean and dry vapor retarder.
 6. Seal all penetrations (including pipes) per manufacturer's instructions.
 7. No penetration of the vapor retarder is allowed except for reinforcing steel and permanent utilities.
 8. Repair damaged areas by cutting and patching with additional sheets, overlapping 6 inches and taping all sides with manufacturer's recommended tape.

3.8 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.
- D. Installation tolerances:
1. Top and bottom bars in slabs, girders, beams and joists:
 - a. Members 8" deep or less: $\pm 3/8"$
 - b. Members more than 8" deep: $\pm 1/2"$
 2. Concrete Cover to Formed or Finished Surfaces: $\pm 3/8"$ for members 8" deep or less; $\pm 1/2"$ for members over 8" deep, except that tolerance for cover shall not exceed 1/3 of the specified cover.
- E. Concrete Cover: As indicated.
- F. Splices: Provide standard reinforcement splices by lapping and tying ends. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents. No. 14 and 18 bars shall not be lap spliced.

- G. Mechanical Splices: Use for splicing of bars larger than no. 11 or where no. 11 bars are spliced to larger size bars and where indicated on the drawings. Comply with manufacturer's instructions for preparation of bars and installation procedures.
- H. Field Welding of Embedded Metal Assemblies: All paint and galvanizing shall be removed in areas to receive field welds. All areas where paint or galvanizing has been removed shall be field repaired with the specified paint or cold galvanizing compound, respectively.
- I. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- J. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.9 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect and Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys as indicated on drawings.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Grade: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.10 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of the Work. Field fabricate joints in waterstops according to manufacturer's written instructions.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

3.11 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Engineer.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as approved by the Engineer and Architect. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that

have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.12 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, to be covered with a coating or covering material applied directly to concrete.

- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.13 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated, to receive trowel finish, and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated, exposed to view, or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
 - a. Specified overall values of flatness at carpeted floors, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - b. Specified overall values of flatness at unpolished concrete exposed to view or to receive thin floorings, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17.
 - c. Specified overall values of flatness at polished concrete, F(F) 50; and of levelness, F(L) 30; with minimum local values of flatness, F(F) 35; and of levelness, F(L) 20.
 - d. Specified overall values of flatness for carpeted slabs on metal deck, F(F) 30; with minimum local values of flatness, F(F) 20.
 - e. Measurement of levelness at slabs on metal deck, 80% or more of the elevation points measured using ASTM procedures after deflection has occurred shall fall within a 3/4" envelope.
 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated and where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- G. Slip-Resistive Finish: Before final floating, apply slip-resistive aluminum granule finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 2. After broadcasting and tamping, apply float finish.
 3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aluminum granules.
- H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows:
1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.

2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.14 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.
- E. Protective slabs ("Mud slabs"): Concrete fill shall be normal weight concrete (2500 psi minimum) with a minimum thickness of 2". Finish slab to a wood float finish.

3.15 INSTALLATION OF NON-SHRINK GROUT UNDER BASEPLATES

- A. Grout under all load bearing baseplates. Comply with manufacturer's instructions. Do not dry pack.
- B. Mixing: Use a mechanical mixer. Add only enough water to make grout placeable. Do not mix more grout than can be placed in 20 minutes. Under no circumstances shall grout be retempered.

3.16 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308R-01 Guide to Curing Concrete (Reapproved 2008), by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.17 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
 - 1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 - 2. Do not apply to concrete that is less than 14 days old.
 - 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Polished Concrete Floor Treatment: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
 - 1. Machine grind floor surfaces to receive polished finishes level and smooth.
 - 2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
 - 3. Continue polishing with progressively finer grit diamond polishing pads to gloss level to match approved mockup.
 - 4. Control and dispose of waste products produced by grinding and polishing operations.
 - 5. Neutralize and clean polished floor surfaces.
- C. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.18 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least six month(s) unless approved otherwise. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.19 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface. Patches exposed to view shall be approved by Architect and Engineer.
 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 2. After concrete has cured at least 14 days, correct high areas by grinding.
 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's and Engineer's approval.

3.20 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Concrete placement, including conveying and depositing.
 - 6. Curing procedures and maintenance of curing temperature.
 - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 7. Compression Test Specimens: ASTM C 31/C 31M.

- a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M.
- a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

3.21 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings, general provisions of the Contract, and other related construction documents such as Division 1 specifications apply to this Section

1.02 SUMMARY

- A. This Section includes a cement-based self-leveling underlayment formulated for interior use.
- B. Related sections include the following:
 - 1. Section 01 45 23 – Concrete In-Situ Relative Humidity, and pH Testing.
 - 2. Section 03 30 00 - Cast-In-Place Concrete.
 - 3. Section 07 26 13 – Moisture Control System.
 - 4. Section 12 48 13 – Entrance Floor Mats and Frames: Installing hydraulic cement underlayment in the slab depression for entrance mat in order to provide a level surface for the entrance mat and frame.

1.03 REFERENCES

- A. ASTM C78- Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
- B. ASTM C109M – Compressive Strength Air-Cure Only.
- C. ASTM C150 – Standard Specification for Portlane Cement.
- D. ASTM C348 – Flexural Strength of Hydraulic-Cement Mortars.
- E. ASTM E84 – Surface Burning Characteristics of Building Materials.
- F. ASTM F2170, Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- G. ASTM 710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

1.04 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used. Include manufacturer's Material Safety Data Sheets.

1.05 QUALITY ASSURANCE

- A. Installation of the underlayment product must be completed by a factory-trained applicator using mixing equipment and tools approved by the manufacturer.

- B. Product must have a hydraulic cement-based inorganic binder content as the primary binder which includes Portland cement per ASTM C150: Standard Specification for Portland Cement and other specialty hydraulic cements.
- C. Manufacturer Experience: Provide products of this section by companies which have successfully specialized in production of this type of work for not less than 10 years. Contact manufacturer's representative prior to installation.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.
- B. Store products in a dry area with temperature maintained between 50 degrees and 85 degrees F (10 degrees and 29 degrees C) and Protect from direct sunlight.
- C. Handle products in accordance with manufacturer's printed recommendations.

1.07 PROJECT CONDITIONS

- A. Do not install material below 50 degrees F (10 degrees C) surface and air temperatures. These temperatures must also be maintained during and for 48 hours after the installation of products included in this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and product named. Other manufacturers with products having equivalent characteristics may be submitted in accordance with Conditions of the Contract and appropriate Division 1 sections. Submitted products shall meet or exceed the performance and physical properties identified in Article 2.01, Paragraph B, of this specification.
 - 1. Manufacturer: Ardex Engineered Cements.
 - 2. Product: Ardex K15 self-leveling underlayment concrete.
 - a. Primer for porous concrete: Ardex P51 primer.
- B. Performance and Physical Properties:
 - 1. Material: Portland cement-based underlayment.
 - 2. Compressive strength: 4,100 psi at 28 days per ASTM C109M.
 - 3. Flexural strength: 1,000 psi at 28 days, per ASTM C78.
 - 4. Maximum installation thickness without aggregate: 1-1/2 inches.
 - 5. Maximum installation thickness with aggregate: 5 inches.

6. VOC content: 0 g/L per SCAQMD 1168.

C. Approved manufacturers and products

1. USG Durock Speed Self-leveling Underlayment.

Note: At locations where the thickness of the underlayment does not exceed 1 inch provide USG Durock Quik-Cover Self-Leveling Underlayment.

2.02 WATER

A. Water shall be clean, potable and sufficiently cool (not warmer than 70 degrees F).

PART 3 EXECUTION

3.01 PREPARATION

A. Concrete Subfloors: Prepare substrate in accordance with manufacturer's instructions.

1. Prior to proceeding refer to ASTM F710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring. All concrete subfloors must be sound, solid, clean, and free of all oil, grease, dirt, curing compounds and any substance that might act as a bond breaker before priming. Mechanically clean if necessary using shot blasting or other. Acid etching and the use of sweeping compounds and solvents are not acceptable.

2. All cracks in the subfloor shall be repaired to minimize telegraphing through the underlayment.

3. Substrates shall be tested in accordance with Section 01 45 23 and corrected for moisture or any other conditions that could affect the performance of the underlayment or the finished floor covering. For areas where moisture vapor emissions exceed the limits required by the floor covering manufacturer, refer to Section 07 26 13 and install the appropriate moisture control system as recommended by underlayment manufacturer.

B. Joint Preparation:

1. Moving joints: Honor all expansion and isolation joints up through the underlayment.

a. Seal joints with Ardiseal RapidPlus as manufactured by Ardex.

2. Saw cuts and control joints: Fill all non-moving joints with Ardifix joint filler as manufactured by Ardex.

3.02 APPLICATION OF UNDERLAYMENT

A. Examine substrates and conditions under which materials will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Coordinate installation with adjacent work to ensure proper sequence of construction.

Protect adjacent areas from contact due to mixing and handling of materials.

C. Priming:

1. Primer for standard absorbent concrete subfloors: Mix Ardex P-51 1:1 with water and apply evenly with a soft push broom. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry to a clear, thin film (minimum three hours; maximum 24 hours). Underlayment shall not be applied until the primer is dry. Primer coverage is approximately 400 to 600 square feet per gallon.
2. Primer for extremely absorbent concrete subfloors: Make an initial application of Ardex P-51 mixed with three parts water using a soft push broom. Do not leave any bare spots. Remove all puddles and excess primer. Allow to dry thoroughly before proceeding with the standard application of primer as described above for standard absorbent concrete.

D. Mixing: Comply with manufacturer's printed instructions and the following:

1. Add 7 quarts (6.5 L) of clean potable water per two 55-pound bag.
2. Mix using a 1/2-inch (650 rpm) low speed heavy-duty mixing drill with an Ardex T-1 mixing paddle. Do not overwater.

E. Application: Comply with manufacturer's printed instructions and the following:

1. Ardex K15 must be installed at a minimum thickness of 1/8 inch over the highest point in the floor, which typically results in an average thickness of 1/4 inch over the entire floor. Ardex K15 can be installed up to 1-1/2 inches over large areas neat, and up to 5 inches with the addition of proper aggregate. Ardex K15 can also be featheredged to match existing elevations.
2. Pour the liquid Ardex K15 and spread in place with the Ardex T-4 Spreader. Use the Ardex T-5 Smoother and featheredge and touch-up. Wear non-metallic cleats to avoid leaving marks in the liquid Ardex K15.

F. Curing

1. Ardex K15 can be walked on in two to three hours. Underlayment can accept all other finish floor covering materials after 16 hours at 70 degrees F and 50 percent relative humidity.

3.03 PROTECTION

- A. Prior to the installation of the entrance floor mat and frame, the surface of the underlayment should be protected from abuse by other trades by the use of plywood, Masonite or other suitable protection course.

END OF SECTION

SECTION 04 05 03 – MASONRY MORTAR AND GROUT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Mortar for masonry.
- B. Mortar for stone.
- C. Mortar for cast stone.
- D. Grout for masonry.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 40 00 – Quality Requirements.
- C. Section 01 45 29 – Testing Laboratory Services: Testing requirements.
- D. Section 01 60 00 – Product Requirements: Product substitution procedures.
- E. Section 04 20 00 – Unit Masonry: Installation of mortar and grout.
- F. Section 04 20 19 – Veneer Unit Masonry: Installation of mortar.
- G. Section 04 43 13 - Mortar-Placed Stone Veneer.
- H. Section 04 72 00 – Cast Stone Masonry: Installation of mortar.

1.03 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530/ASCE 5/TMS 402 – Building Code Requirements for Masonry Structures. (Edition referenced in the applicable building code.)
 - 2. ACI 530.1/ASCE 6/TMS 602 – Specifications for Masonry Structures. (Edition referenced in the applicable building code.)
- B. ASTM International:
 - 1. ASTM C94 – Standard for Ready-Mixed Concrete.
 - 2. ASTM C143 – Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - 3. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar.
 - 4. ASTM C150 – Standard Specification for Portland Cement.
 - 5. ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes.

6. ASTM C270 – Standard Specification for Mortar for Unit Masonry.
7. ASTM C404 – Standard Specification for Aggregates for Masonry Grout.
8. ASTM C476 – Standard Specification for Grout for Masonry.
9. ASTM C780 – Standard Test Method for Pre-Construction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
10. ASTM C979 – Standard Specification for Pigments for Integrally Colored Concrete.
11. ASTM C1586 – Standard Guide for Quality Assurance of Mortars.

1.04 SUBMITTALS

- A. Submit mortar mix designs indicating type and proportions of ingredients in compliance with the proportion specification of ASTM C270.
- B. Test and evaluation reports for mortar to ASTM C780 for aggregate ratio and water content.
- C. Submit grout mix designs indicating type and proportions of ingredients in compliance with ASTM C476 – Conventional Grout Proportions by Volume for fine and coarse grout.
- D. Submit product data under provisions of Section 01 33 00.
 1. Submit manufacturer of mortar pigment, procedures for mixing colored mortar.
 2. For each mortar material used, submit a letter of certification or a test report confirming that the materials meet the ASTM Standards listed under the Materials Section of Specification C270.
 3. For each grout material used, submit a letter of certification or a test report confirming that the materials meet ASTM Standards listed under the Materials Section of Specification C476.
 4. Obtain written acceptance of submittals prior to the purchase of the materials or methods requiring acceptance.
- E. Samples: Submit under provisions of Section 01 33 00.
- F. Samples: Submit two ribbons of each mortar color, illustrating color and color range.
- G. Submit test reports under provisions of Section 01 40 00.
- H. Submit manufacturer's certificate under provisions of Section 01 40 00 that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with the Building Code for Masonry Structures ACI 530/ASCE 5/TMS 402 and Specifications for Masonry Structures ACI 530.1/ASCE 6/TMS 602, and commentaries. Comply with edition referenced in applicable building code.

1.06 QUALITY ASSURANCE FOR MORTAR PIGMENT

- A. ASTM C979: Pigment shall not exceed 10 percent of the weight of Portland cement.
- B. Carbon Black shall not exceed 2 percent of the weight of Portland cement.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site under provisions of Section 01 60 00.
- B. Store and protect products under provisions of Section 01 60 00.
- C. Maintain packaged materials clean, dry and protected against dampness, freezing and foreign matter.
- D. Stock pile and handle aggregates to prevent contamination from foreign materials.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Follow requirements for cold and hot weather construction in ACI 530.1/ASCE6.
 - 1. Cold Weather Requirements: When ambient air temperature is below 40 degrees F (4.4 degrees C), implement cold weather procedures.
 - 2. Hot Weather Requirements: When the ambient air temperature exceeds 100 degrees F (37.8 degrees C), or exceeds 90 degrees F (32.2 degrees C) with a wind velocity greater than 8 mph (12.9 km/hr), implement hot weather procedures.

PART 2 PRODUCTS

2.01 MORTAR MATERIALS

- A. Cementitious Materials:
 - 1. Portland Cement: ASTM C150, Type 1.
 - a. Color:
 - 1) Provide gray colored cement unless otherwise noted.
 - 2) At colored mortar, provide gray colored cement for mixing with mortar colors.
 - 2. Hydrated Lime: ASTM C207, Type S.
 - 3. The use of Masonry Cement will not be permitted.
- B. Sand: ASTM C144, Standard Masonry Type.
- C. Admixtures:
 - 1. No air-entraining admixtures or material containing air entraining admixture.
 - 2. No anti-freeze compounds shall be added to mortar.

3. No admixtures containing calcium chlorides shall be added to mortar.
 4. Set-retarding or set-accelerating, bond-modifying or corrosion-inhibiting admixtures are prohibited without written approval from the Architect and the governing building official.
- D. Water: Clean and Potable.
- E. Mortar Pigment:
1. Mortar Pigment shall be finely milled (95 percent to 99 percent minus 325 mesh particle size), 90 percent pure inorganic iron oxides. Carbon added for darker shades shall not exceed 4 percent. Color pigments shall be light fast, weather resistant, alkali resistant, water insoluble, lime proof, nonbleeding, free of deleterious fillers and extenders as manufactured by SGS Solomon Colors, Inc., H series colors.
 - a. At exterior clay masonry veneer: Mortar colors selected by Architect.
 - b. At exterior stone: Mortar color selected by Architect.
 - c. At cast stone: Mortar color selected by Architect.

2.02 GROUT MATERIALS

- A. This specification covers both fine and coarse grout for use in the construction of masonry structures.
1. Each type (fine and coarse) shall be classified as conventional grout, requiring mechanical consolidation by puddling or vibration when placed.
 2. Conventional grout shall be determined by the following method:
 - a. Proportions by volume for fine and coarse grout.
 3. Grout type:
 - a. Fine grout shall be manufactured with fine aggregates.
 - b. Coarse grout shall be manufactured with a combination of coarse and fine aggregates.
- B. Cementitious Materials:
1. Portland Cement: ASTM C150, Type 1.
 2. Hydrated Lime: ASTM C207, Type S.
- C. Aggregates:
1. Fine Aggregate: ASTM C404.
 2. Coarse Aggregate: ASTM C404.
- D. Water: Clean and Potable.

E. Admixtures:

1. No air-entraining admixtures or material containing air-entraining admixture.
2. No anti-freeze compounds shall be added to the grout.
3. No admixtures containing chlorides shall be added to the grout.
4. Set-retarding or set-accelerating, bond-modifying or corrosion-inhibiting admixtures are prohibited without written approval from the architect and the governing building official.

2.03 MORTAR MIXES

A. Mortar Mixes:

1. Mortar for calcium silicate brick veneer, stone veneer, and cast stone: ASTM C270, Type N using the proportion specification.
 - a. At the calcium silicate brick provide a Type N Portland cement-lime mix proportioned as follows:
 - 1) 1 part Portland cement, ASTM C150, Type 1).
 - 2) 1 part hydrated lime (ASTM C207, Type S.
 - 3) 6 parts masonry sand (ASTMC144).
2. Mortar for non-load-bearing concrete masonry walls; ASTM C270, Type S using the proportion specification.

2.04 GROUT MIXING

- A. Grout for Non-Structural Masonry: 8 to 11 inches slump unless otherwise indicated in the Structural General Notes: mixed in accordance with ASTM C476 grout.
- B. Provide grout proportions by volume for both fine and coarse conventional grout.
- C. Place grout within 1 hour from introducing water in the mixture and prior to initial set.

PART 3 EXECUTION

3.01 FIELD MORTAR MIXING

- A. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
 1. All cementitious materials and aggregate shall be mixed between three and five minutes in a mechanical batch mixer with the maximum amount of water to produce a workable consistency. Do not hand-mix mortar.
 2. Control batching procedures to ensure proper proportions by measuring materials by volume. Sand measurement by shovel count shall not be permitted.

- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Do not use anti-freeze compounds to lower the freezing point of mortar.
- D. If water is lost by evaporation, re-temper with water only within two hours of initial mixing, re-temper with potable water.
- E. Discard all mortar which has begun to stiffen or is not used within two hours after initial mixing.
- F. Where required, mix mortar color in accordance with manufacturer's printed instructions to achieve uniformity of mix and coloration.

3.02 FIELD GROUT MIXING

- A. Grout shall comply with the requirements of Standard Specifications for Grout of Masonry, ASTM C476 for either fine grout or coarse grout. Transit mixed grout shall comply with ASTM C94.
 - 1. Under no circumstances will mortar be allowed to be placed periodically in the cavity as a substitute for poured grout. The operation shall be considered separate and distinct.
- B. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476 grout.
- C. Grout shall be of the consistency indicated such as to completely fill air spaces intended to receive grout. Refer to table for grout space requirements.

Grout space requirements

Grout type ¹	Maximum grout pour height, ft.	Minimum width of grout space, ^{2,3} in.	Minimum grout space dimensions for grouting cells of hollow units, ^{3,4} in. x in.
Fine	1	3/4	1-1/2 x 2
Fine	5	2	2 x 3
Fine	12	2-1/2	2-1/2 x 3
Fine	24	3	3 x 3
Coarse	1	1-1/2	1-1/2 x 3
Coarse	5	2	2-1/2 x 3
Coarse	12	2-1/2	3 x 3
Coarse	24	3	3 x 4

¹Fine and coarse grouts are defined in ASTM C476.

²For grouting between masonry wythes.

³Grout space dimension is the clear dimension between any masonry protrusion and shall be increased by the diameters of the horizontal bars within the cross section of the grout space.

⁴Area of vertical reinforcement shall not exceed 6 percent of the area of the grout space.

- D. Do not use anti-freeze compounds to lower the freezing point of grout.

3.03 INSTALLATION

- A. Install mortar and grout in accordance with Specifications for Masonry Structure, ACI 530.1/ASCE 6.
- B. Work grout into masonry cores and cavities to eliminate voids.
- C. Do not install grout in lifts greater than 16 inches without consolidating grout by rodding.
- D. Do not displace reinforcement while placing grout.
- E. Remove excess mortar from grout spaces.

3.04 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 45 29.
 - 1. Testing of grout mix: In accordance with ASTM C143 for slump.
 - 2. Field inspection of mortar: Verify by observation that the method of measuring material quantities used in construction accurately maintains the required proportions. Verify that the individual mortar materials being used are those approved for the project.
 - 3. Per ASTM C1586, use test method ASTM C780 to evaluate masonry mortar prepared at the construction site for the following properties:
 - a. Mortar aggregate ratio and water content, Test Method ASTM C780, Annex A4.
 - a. The measured volumetric proportions of the construction site produced mortar will then be compared to specification ASTM C270 Proportion Specification.

END OF SECTION

SECTION 04 20 00 – UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete masonry units.
- B. Reinforced unit masonry.
- C. Reinforcement, and accessories.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 60 00 – Product Requirements: Product substitution procedures.
- C. Section 03 20 00 – Concrete Reinforcing: Steel reinforcing.
- D. Section 04 05 03 – Masonry Mortar and Grout: Mortar and grout.
- E. Section 04 20 19 – Veneer Unit Masonry: Masonry veneer.
- F. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Air barrier placed on exterior face of concrete block.
- G. Section 07 65 10 – Flexible Flashing: Installation of through wall flashing.

1.03 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530/ASCE 5/TMS 402 – Building Code Requirements for Masonry Structures. (Edition referenced in applicable building code.)
 - 2. ACI 530.1/ASCE 6/TMS 602 – Specifications for Masonry Structures. (Edition referenced in applicable building code.)
- B. ASTM International:
 - 1. ASTM A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 2. ASTM C90 – Standard Specification for Load-Bearing Concrete Masonry Units.
 - 3. ASTM C426 – Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.

- B. Product Data: Provide data for concrete masonry units and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602. (Edition referenced in the applicable building code.)

1.06 FINISH AND APPEARANCE

- A. All units shall be sound and free of cracks or other defects that interfere with the proper placement of the unit or significantly impair the strength or permanence of the construction. Minor cracks, incidental to the usual method of manufacture or minor chipping resulting from customary methods of handling in shipment and delivery, are not grounds for rejection.
- B. Five percent of a shipment containing chips, not larger than 1 inch in any dimension, or cracks not wider than 0.02 inch and not longer than 25 percent of the nominal height of the unit is permitted.
- C. The color and texture of units shall be specified by the Architect.
- D. A shipment shall not contain more than 5 percent of units, including broken units, that do not meet the requirements of A, B and C.

1.07 PERMISSIBLE VARIATIONS IN DIMENSIONS

- A. Standard Units: For standard units, no overall dimension (width, height and length) shall differ by more than $\pm 1/8$ inch from the specified dimensions.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 10 years of documented experience.
- B. Installer: Company specializing in performing work of this section with minimum five years of documented experience.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion and other causes. If units become wet, do not install until they are in an air-dried condition.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.10 PROJECT CONDITIONS

- A. Protection of Masonry: During erection, cover tops of walls with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Hot and cold weather requirements: Follow requirements for cold and hot weather construction in ACI 530.1/ASCE 6/TMS 602.
 - 1. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F (38 degrees C) or ambient temperature is greater than 90 degrees F (32 degrees C) with a wind velocity greater than 8 mph.
 - 2. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F (4 degrees C).

1.12 COORDINATION

- A. Coordinate work under provisions of Section 01 30 00 – Administrative Requirements.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Hollow Load-Bearing Block Units (CMU): ASTM C90 medium weight, (oven dry density of concrete, lb/ft³ 105 to less than 125). Maximum Linear Drying Shrinkage shall be 0.065 percent as determined by ASTM Test Method C426. Provide units with the minimum average net area required to produce concrete unit masonry construction of the compressive strength indicated in this specification.
 - 1. The compressive strength based on net cross-sectional area shall be 1,800 psi for individual units and 2,000 psi for the average of three units.
- B. Provide hollow concrete masonry units with nominal face dimension of 8 inches and in the nominal thickness as shown on the Drawings.
- C. Shapes: Provide the following shapes for each masonry unit required:
 - 1. Regular Stretcher Units.
 - 2. Bond Beams.

2.02 REINFORCING STEEL

- A. Steel Reinforcing Bars, ASTM A615, Grade 60, Deformed.

2.03 MORTAR AND GROUT

- A. Mortar and Grout: As specified in Section 04 05 03.

2.04 FLEXIBLE FLASHINGS

- A. Through Wall Flexible Flashings: As specified in Section 07 65 10.

2.05 WEEP VENTS

- A. Weep Vents: As specified in Section 04 20 19.

2.06 ACCESSORIES

- A. Rebar Positioners: Hohmann & Barnard #RB hot-dip galvanized 9- gauge wire or approved equal.
- B. Cleaning Solution: Solution not harmful to masonry work or adjacent materials approved by block manufacturer

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other sections of work are properly sized and located.
- C. Verify that built-in items are in proper location and ready for roughing into masonry work.

3.02 COURSING

- A. Establish lines, levels and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond:
 - a. Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches, for nominal 8-inch-high units.
 - 3. Mortar Joints: Concave.

3.03 PLACING AND BONDING

- A. Prior to placing masonry, remove laitance, loose aggregate and anything else that would prevent mortar from bonding.
- B. Bed and Head Joint Thickness: 3/8 inch.
- C. Bed Joint at Starting Course of Foundations: 1/4 inch minimum to 3/4 inch maximum.

- D. Hollow Units:
 - 1. Lay hollow masonry units with full mortar coverage on horizontal and vertical face shells.
 - 2. Bed webs in mortar in starting course on footings and where adjacent to cells or cavities to be filled with grout. At all walls specified to be solidly grouted, do not mortar cross webs.
 - a. Allow grout to come in direct contact with foundation or bearing surface.
 - 3. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
 - 4. Vertical cells noted to be grouted shall be aligned and openings for grout shall be unobstructed.
 - 5. Remove masonry protrusions extending 1/2 inch or more into cells or cavities that are to be grouted.
- E. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- F. Remove excess mortar as work progresses.
- G. Interlock external corners.
- H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- I. Unless otherwise required, do not wet concrete masonry.
- J. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges. Installation of masonry units with chipped corners shall not be permitted.
- K. Built-In Work: As construction progresses, build in items specified under this and other sections of the Specifications. Fill in solidly with masonry around built-in items.
- L. Cut mortar joints flush where air barriers are scheduled.
- M. At double-wythe walls, build inner wythe ahead of outer wythe to receive fluid applied membrane air barrier.

3.04 MASONRY FLASHING

- A. General:
 - 1. Coordinate with Section 07 65 10 – Flexible Flashing.
 - 2. Protect flexible flashing from damage. Prior to installing masonry, inspect flashing for any damage including punctures, tears or loose scrim. Immediately notify contractor of any damage to flexible flashing. Do not proceed with work until

flashing has been repaired or replaced in accordance with flexible flashing manufacturer's instructions.

3.05 GROUTED COMPONENTS

- A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- B. Place and consolidate grout fill without displacing reinforcing.

3.06 GROUTED MASONRY

- A. Lay masonry units with core cells vertically aligned clear of mortar and unobstructed.
- B. Prior to placing grout verify the following:
 - 1. All head and bed joints are filled with mortar for the full thickness of the face shell.
 - 2. Where walls are partially grouted, the webs adjacent to the cores to be grouted shall be mortared to confine the grout.
 - 3. Where walls are solidly grouted, the cross webs shall not be mortared in order to allow the grout to flow between concrete block units.
 - 4. At the top of the foundation/footing the concrete surfaces is not covered with mortar in order to allow the grout to come in direct contact with the concrete.
 - 5. Where foundation dowels are installed, verify dowels align with the cores of the masonry units.
 - a. Dowels that interfere with the placement of the units may be bent a maximum of 1 inch horizontally for every 6 inches vertically.
 - b. Walls which are to be solidly grouted, saw cutting or chipping away a portion of the web to accommodate the dowel will be acceptable if approved by the Architect.
 - c. All dowel alignment issues shall be brought to the attention of the Architect.
 - 6. Allow mortar to cure 24 hours before placing grout for single-wythe masonry.
 - 7. Grout spaces shall be free of mortar droppings, debris, loose aggregates and any material deleterious to masonry grout. Use an air hose to remove debris.
- C. Reinforce masonry unit cores with reinforcement bars as indicated prior to grouting.
- D. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 48 inches, using specified rebar positioners. Splice reinforcement in accordance with typical structural masonry details.
- E. Do not wet masonry unit surfaces in contact with grout prior to grout placement.
- F. Place grout in accordance with MSJC specifications.

- 1. Definitions:
 - a. Grout pour: The total height of masonry to be grouted before additional masonry is installed. Refer to Section 04 05 03 for the maximum grout pour height.
 - b. Grout lift: Amount of grout placed in a single continuous operation.
- 2. Low-lift grouting where the wall is constructed to pour heights up to 5 feet without cleanouts.
- 3. Grout lifts shall not exceed 5 feet.
- G. When grouting is stopped for more than one hour, terminate grout 1-1/2 inches below top of upper masonry unit to form a positive key for subsequent grout placement.
- H. Place grout within one hour from introducing water in the mixture and prior to initial set.
- I. Consolidation and Reconsolidation:
 - 1. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.
 - 2. Consolidate pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

3.07 TOLERANCES

- A. Inspection: Prior to the start of masonry construction the masonry contractor shall verify:
 - 1. That foundations are constructed with tolerances conforming to the requirements of ACI 117.
 - 2. That vertical reinforcing dowels are positioned in accordance with the Contract Drawings.
 - 3. The masonry contractor shall notify the General Contractor or construction manager immediately of any discrepancies. The General Contractor or construction manager shall immediately notify the Architect of the discrepancies. The installation of masonry shall not proceed until all deficiencies have been corrected.

Copy of Section 3 – Foundations printed below for reference.

ACI 117

Section 3- Foundations (ref. 4)

3.2-Lateral alignment

3.2.1 Footings

As cast to the center of gravity as specified; 0.02 times width of footing in direction of misplacement but not more than.....2 in.
Supporting masonry.....1/2 in.

3.3-Level alignment

- 3.3.1 Footings
 - Top of footings supporting masonry.....1/2 in.
 - Top of other footings+1/2 in, -2 in.
- 3.4-Cross-sectional dimensions**
- 3.4.1 Footings
 - 3.4.1.1 Horizontal dimension of formed members.....+2 in. -1/2 in.
 - 3.4.1.2 Horizontal dimension of unformed members cast against soil,
2ft or less.....+3 in., -1/2 in.
greater than 2 ft but less than 6 ft.....+ 6 in., -1/2 in.
over 6 ft.....+12 in., -1/2 in.
 - 3.4.1.3 Vertical dimension (thickness).....-5 percent

B. Site Tolerances: Erect masonry within the following tolerances from the specified dimensions:

- 1. Dimensions of elements
 - a. In cross-section of elevation.....-1/4 inch, +1/2 inch.
 - b. Mortar joint thickness
 - bed.....±1/8 inch
 - head.....-1/4 inch, +3/8 in.
 - collar.....-1/4 inch, +3/8 in.
 - c. Grout space or cavity width.....-1/4 inch, +3/8 in.
- 2. Elements
 - a. Variation from level:
 - Bed joints.....±1/4 inch in 10 feet
.....±1/2 inch maximum
 - Top surface of bearing walls.....±1/4 inch in 10 feet
.....±1/2 inch maximum
 - b. Variation from plumb.....±1/4 inch in 10 feet
.....±3/8 inch in 20 feet
.....±1/2 inch maximum
 - c. True to a line.....±1/4 inch in 10 feet
.....±3/8 inch in 20 feet.
.....±1/2 inch maximum
 - d. Alignment of columns and walls (bottom versus top)
 -±1/2 inch for bearing walls
 -±3/4 inch for nonbearing walls
- 3. Location of elements
 - a. Indicated in plan.....±1/2 inch in 20 feet
.....±3/4 inch maximum
 - a. Indicated in elevation.....±1/4 inch in story height
.....±3/4 inch maximum

C. Maximum Variation for steel reinforcement:

- 1. Plus or minus 1/2 inch when distance from center line of steel to opposite face of masonry is 8 inches or less.

2. Plus or minus 1 inch when distance is between 8 and 24 inches.
3. Plus or minus 1-1/4 inches when distance is greater than 24 inches.
4. In walls, for vertical bars, 2 inches from the location along the length of the wall.

3.08 CLEANING

- A. Clean work under provisions of Section 01 70 00.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.09 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 70 00.
- B. Protect base of walls from mud and mortar splatter.
- C. Protect tops of masonry with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when work is not in progress.

3.10 MASONRY WASTE DISPOSAL

- A. Recycling: Undamaged, excess masonry materials are contractor's property and shall be removed from the project site.
- B. Excess masonry waste: Remove and legally dispose of masonry waste off Owner's property. Do not use as fill material.

END OF SECTION

SECTION 04 20 19 – VENEER UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Calcium silicate brick.
- B. Anchorage, and Accessories.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 40 00 – Quality Requirements.
- C. Section 01 60 00 – Product Requirements: Product substitution procedures.
- D. Section 04 05 03 – Masonry Mortar and Grout: Mortar.
- E. Section 04 20 00 – Unit Masonry: Securing masonry anchors to concrete block.
- F. Section 04 72 00 – Cast Stone Masonry: Cast stone sills and copings.
- G. Section 05 40 00 – Cold-Formed Metal Framing: Exterior light-gauge steel framing for curtain wall.
- H. Section 06 10 53 – Miscellaneous Carpentry: Corrosion-resistant fasteners used to secure through wall flashing to treated wood nailers.
- I. Section 06 16 43 – Gypsum Sheathing: Glass-faced wall sheathing.
- J. Section 07 21 00 – Continuous Thermal Insulation: Board insulation installed in cavity.
- K. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Liquid membrane installed over glass-faced gypsum sheathing and/or concrete block or concrete back-up.
 - 1. Sealants used to seal masonry veneer anchors to the fluid applied membrane air barrier and penetrations of the fluid applied membrane air barrier by fasteners shall be compatible with fluid applied membrane air barrier specified in Section 07 27 26.
 - 2. Sealants used to seal masonry veneer anchors and penetrations of the fluid applied membrane air barrier by expansion anchors in concrete block and/or concrete back up shall be compatible with fluid applied membrane air barrier specified in Section 07 27 26.
- L. Section 07 65 10 - Flexible Flashing: Installation of through wall flashing.
- M. Section 07 90 00 – Joint Protection: Rod and sealant at control and expansion joints and perimeter joints.

1.03 REFERENCES

A. American Concrete Institute:

1. ACI 530/ASCE 5/TMS 402 – Building Code Requirements for Masonry Structures. (Edition referenced in applicable building code.)
2. ACI 530.1/ASCE 6/TMS 602 – Specifications for Masonry Structures. (Edition referenced in applicable building code.)

B. ASTM International:

1. ASTM A36 – Standard Specification for Carbon Structural Steel.
2. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A951 – Standard Specification for Steel Wire for Masonry Joint Reinforcement.
4. ASTM A1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low Alloy with Improved Formability, Solution Hardened, and Bare Hardenable.
5. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, For Concrete.
6. ASTM B117- Standard Practice For Operating Salt Spray (Fog) Apparatus.
7. ASTM C73 – Standard Specification for Calcium Silicate Face Brick.
8. ASTM D1056- Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

1.04 QUALITY ASSURANCE

- A. Perform Work in accordance with current ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602.

1.05 MOCK-UP

A. Construct a sample panel showing:

1. Calcium Silicate Brick: Proposed color range, texture and bond.
2. Mortar.
3. Structural Backing.
4. Veneer Anchors.
5. Flashings and Sealing the Top of the Flashing.

6. Weep Vents.
 7. Wall Insulation.
 8. Air Barrier.
 9. Vertical Expansion Joint with Sealant and Backer Rod.
- B. Refer to Construction Drawings for design of sample panel.
- C. Locate where directed.
- D. Mock-up may not remain as part of the work.
- E. Do not start work until Architect has accepted sample panel.
- F. Use panel as standard of comparison for all masonry work built of the same material.
- G. Do not destroy or move panel until work is completed and accepted by the Owner.
- H. Mock up Notes

Phase One: Construct mock up using the following materials:

1. Metal stud back up.
2. 1/2-inch sheathing at metal stud back up.
3. Wood nailers around the perimeter of the window frame.
4. Air barrier material.
5. Window frame with glass.
6. Flashing window frame to air barrier membrane.
7. Loose lintel.
8. Through wall flashing at base of wall and above window head.
9. Masonry ties.
10. Board Insulation: Installed on half of the mock up.

Phase Two: After the mock up has been reviewed and approved install the following materials.

1. Masonry veneer.
2. Cast stone sill.
3. Sealants around the perimeter of the window frame and vertical control joint.

1.06 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures. Obtain written acceptance of submittals prior to the purchase of the materials or methods.
- B. Product Data: Provide data for fabricated ties and anchors, and accessories as specified.
- C. Samples: Provide five individual brick samples of each color specified to illustrate color, texture and extreme color range.
- D. Certificates: Submit certificates attesting compliance with applicable specifications for grades, types and classes included in these specifications.
- E. Hot- and cold-weather construction procedures for meeting the requirements of these specifications.

1.07 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum five years of documented experience.

1.08 PRE-INSTALLATION CONFERENCE

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Convene minimum four weeks prior to commencing work of this section, at the project site. Give four weeks advance notice to the participants, including the contractor, mason contractor, and flashing installer. Advise the architect of the scheduled meeting date.

1.09 JOB CONDITIONS

- A. Protection of Work.
 - 1. Wall Covering:
 - a. During erection, cover top of wall with strong waterproof membrane at end of each day or shutdown.
 - b. Cover partially completed walls when work is not in progress.
 - c. Extend cover minimum 24 inches down sides, and hold cover securely in place.
- B. Protection of Flexible Flashing Membrane.
 - 1. Protect flexible flashing membrane from damage. Prior to installing masonry, inspect flashing for any damage including punctures, tears or loose scrim. Immediately notify contractor of any damage to flexible flashing. Do not proceed with work until flashing has been repaired or replaced in accordance with flexible flashing manufacturer's instructions.
- C. Staining:
 - 1. Prevent grout or mortar from staining the face of masonry to be left exposed.

- a. Remove immediately grout or mortar in contact with face of such masonry.
- b. Protect all sills, and projections from droppings of mortar; protect door jambs and corners from damage during construction.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 – Product Requirements.
 1. Deliver calcium silicate brick in protective film. Prevent damage to units.
 2. Lift skids with proper and sufficiently long slings or forks with protection to prevent damage to units. Protect edges and corners.
 3. Store units in a manner designed to prevent damage and staining of units.
 4. Stack units on timbers or platforms at least 3 inches above grade.
 5. Place polyethylene or plastic film between wood and other finished surfaces of units when stored for extended periods of time.
 6. Cover stored units with protective enclosure if exposed to weather.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Hot and Cold Weather Requirements: Follow requirements for cold and hot weather construction in ACI 530.1/ASCE6/TMS 602 specifications for masonry structures.

1.12 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and Project Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURER – CALCIUM SILICATE BRICK UNITS

- A. Arriscraft Architectural Linear Series Brick.

2.02 CALCIUM SILICATE BRICK UNITS

- A. Calcium Silicate Brick: ASTM C73, Grade SW; solid units that have been pressure formed and autoclaved.
 1. Size, texture and color:
 - a. Modular size: (t) 3 3/4 inches x (h) 2 3/8 inches x (l) varies up to 23 5/8 inches.
 - b. Texture: Smooth face brick.
 - c. Color: Midnight Gray.

2. At vertical expansion joints do not use the ends of calcium silicate bricks.

2.03 ANCHORAGE

- A. General: The design of the anchored masonry veneer is based on using the Prescriptive Design Methods for areas of high winds where velocity pressures exceeds 40 psf but does not exceed 55 psf for anchored masonry veneers in accordance with the Building Code Requirements for Masonry Structures TMS 402/ACI 530/ASCE 5 and the Specification for Masonry Structures TMS 602/ACI 530.1/ASCE 6 as adopted by the International Building Code. The year of the masonry code shall be in accordance with the International Building Code adopted by the Authority Having Jurisdiction.
 1. In areas of high winds where the wind velocity pressure does not exceed 55 psf and the building's mean roof height is less than or equal to 60 feet, install the masonry veneer anchors in accordance with the Reinforcement and Anchorage Article in Part 3 of this Section.
- B. Adjustable Masonry Veneer Anchors
 1. Provide two-piece assemblies for attachment over sheathing to metal studs and/or concrete/concrete block.
 - a. Anchor: Anchor system for brick, to metal stud, concrete block and/or concrete shall consist of the following:
 - 1) Back Plate: Provide 16 gauge plate.
 - 2) Size: Based on insulation thickness specified in Section 07 21 00 Continuous Thermal Insulation.
 - 3) Sheet metal shall conform to ASTM A1008. Anchor shall be hot-dip galvanizing after fabrication conforming to ASTM A153 Class B2, (1.5 oz./ft²).
 - 4) Products: HB-BL-407 by Hohmann & Barnard for anchoring to metal stud.
 - 5) Products: HB-BL-5407 by Hohmann & Barnard for anchoring to concrete block and/or concrete.
 - b. Tie: Provide masonry Vee Byna wire tie fabricated from cold-drawn steel wire 3/16 inch dia. conforming to ASTM A1064 (tensile strength). Hot-dip galvanizing after fabrication shall conform to ASTM A153 Class B2. Provide length of tie as required to provide a minimum of 2-inch embedment into the brick bed joint with minimum 5/8 inch mortar cover.
 - c. Steel drill screws for steel studs:
 - 1) Self-drilling self-tapping screws; hex washer head, size #10, lengths required to penetrate steel stud flange by not less than 3 exposed threads.
 - 2) Organic polymer coated with salt-spray resistance to red rust of more than 800 hours per ASTM B117.
 - 3) Provide neoprene sealing washers.
 - d. Expansion anchors for concrete and masonry:
 - 1) Hohmann and Barnard BL-523 Brass Expansion Bolt for use with HB-BL-5407 anchor.

2. Substitutions permitted in accordance with Section 01 60 00 – Product Requirements.

2.04 MORTAR

- A. Mortar: As specified in Section 04 05 03 – Masonry Mortar and Grout.

2.05 FLEXIBLE FLASHINGS

- A. Coordinate with Section 07 65 10 – Flexible Flashing.

2.06 ACCESSORIES

- A. Joint Filler: Closed-cell neoprene sponge conforming to ASTM D1056, 3 inch wide, 3/8 inch and 1 inch thick as manufactured by Hohmann and Barnard, Inc. or approved equivalent.
- B. Lintels: Steel lintels shall be hot-dip galvanized ASTM A36 and painted.
- C. Weep Vents: Quadro-Vent #QV 3/8 inch by 2-1/2 inches by 3-3/8 inches weep vents as manufactured by Hohmann & Barnard, Color: as selected by Architect, or approved equivalent.
- D. Cleaning Solution: Approved by brick manufacturer. Cleaning solution shall not be harmful to masonry work or adjacent material.

2.07 SEALANTS

- A. Sealants used to seal masonry veneer anchors to the fluid applied membrane air barrier and penetrations of the fluid applied membrane air barrier by fasteners shall be compatible with fluid applied membrane air barrier specified in Section 07 27 26.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify that field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.
- D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Mix units for exposed unit masonry from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- B. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement type joints, returns and offsets. Avoid the use of less-than-4 inch units at corners, jambs and where possible at other locations.

- C. Wetting of Brick: Where the ambient air temperature exceeds 100 degrees F or exceeds 90 degrees F with a wind velocity greater than 8 miles per hour, pre-wet brick units.
 - 1. Lay wetted units when surface dry.
- D. Cleaning Reinforcement: Before being placed, remove loose rust, ice and other coatings from reinforcement.

3.03 COURSING

- A. Establish lines, levels and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Coursing Brick Units:
 - 1. Bond:
 - a. Random length coursed bond, with a minimum 4 inches overlap of vertical joints.
 - 2. Coursing:
 - a. Three units and three mortar joints to equal 8 1/4 inches.
 - 3. Mortar Joints: Concave.

3.04 PLACING AND BONDING

- A. Lay brick units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Buttering corners of joints or furrowing of mortar joints are not permitted.
- C. Remove excess mortar as Work progresses.
- D. Interlock intersections and external corners, unless otherwise noted on the drawings.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with a masonry splitter. Dress split ends to match face when exposed in wall. Prevent broken masonry unit corners or edges.
- G. Isolate top joint of masonry veneer walls from horizontal structural framing members, slabs and at locations shown.
- H. As construction progresses, build-in items specified under this and other sections of the specifications. Fill in solidly with masonry around built-in items.
- I. Leave joints around outside perimeters of exterior doors, window frames and other wall openings frames as indicated below:

1. Depth: Uniform 3/4 inch.
 2. Width: 1/2 inch.
- J. Lay all masonry with a 3/8-inch head and bed joints, except at foundation. Construct bed joint of the starting course of foundation with a thickness not less than 1/4 inch and not more than 3/4 inch.

3.05 WEEP VENTS

- A. Install weep vents in head joints in exterior wythes at 24 inches o. c. horizontally for brick above through-wall flashing, above lintels, and at bottom of walls. Above window and door openings install weep vents at 16 inches o.c. Install weep vents at top of walls spaced at 24 inches o.c.
1. All weep vents installed in conjunction with through wall flashing shall be placed directly on top of the horizontal surface of the through wall flashing. Do not place on top of the mortar bed joint at this location.

3.06 CAVITY BEHIND VENEER

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weeps.
- B. Slope beds toward cavity to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against cavity face of brick.

3.07 ANCHORAGE

- A. Secure wall ties to stud framed back-up and embed into masonry veneer at maximum 16 1/2 inches o.c. vertically and 16 inches o.c. horizontally. Install additional anchors within 8 inches of all openings larger than 16 inches in either direction and at intervals around the perimeter not exceeding 16 1/2 inches on center vertically and 16 inches on center horizontally.
1. Install wall ties after fluid applied air barrier membrane is installed.
 - a. Coat back of anchor plate with sealant compatible with fluid applied air barrier membrane.
 2. Screw-attach veneer anchor to stud face; ensure full contact of veneer anchor to sheathing. Provide 2 screws per anchor.
 3. Install masonry Vee Byna wall tie at each veneer anchor location; install ties as exterior wythe of masonry construction progresses. Provide each anchor with one tie.
- B. Secure wall ties to concrete block back-up and/or concrete and embed into masonry veneer at maximum 16 1/2 inches o.c. vertically and 16 inches o.c. horizontally.
1. Install wall ties after fluid applied air barrier membrane is installed.
 - a. Coat back of anchor plate with sealant compatible with fluid applied air barrier membrane.

- b. Prior to installing expansion bolt fill drilled hole in concrete block and or concrete with sealant.
- 2. Attach veneer anchor to masonry or concrete surface using expansion bolts for masonry/concrete; ensure full contact of veneer anchor to face of wall surface. Provide 1 bolt per anchor.
- 3. Install masonry Vee Byna wall tie at each veneer anchor location; install ties as exterior wythe of masonry construction progresses. Provide each anchor with one tie.
- C. At vertical expansion and control joints, install additional anchors within 8 inches of joint at 16 ½ inches o.c. vertically.

3.08 FLEXIBLE MASONRY FLASHINGS

- A. Coordinate with Section 07 65 10 – Flexible Flashing.

3.09 LINTELS

- A. Install loose steel lintels over openings and were shown on Drawings.
- B. Maintain minimum 8-inch bearing on each side of opening.

3.10 MASONRY EXPANSION JOINTS

- A. Install masonry expansion joints at the following locations, unless otherwise indicated on Drawings:
 - 1. Exterior Walls: 20 feet on center and within 24 inches on each side of inside and outside corners.
 - 2. At changes in wall height.
 - 3. On one side of openings up to 6'-0" wide. At openings over 6'-0" wide provide joints on each side of opening.
 - 4. At changes in wall thickness.
 - 5. Above movement joints in foundations and floors.
 - 6. At offset and setbacks.
- B. Do not install adjustable masonry veneer anchors through expansion joints.
- C. Install joint filler in continuous lengths. Set face of joint filler 1-1/2 inches in from outside face of brick or block.
- D. Size expansion joint in accordance with Section 07 90 00 for sealant performance.

3.11 TOLERANCES

- A. Maximum variation from plumb in vertical lines and surfaces of columns, walls and arises:

1. 1/4 inch in 10 feet.
 2. 3/8 inch in a story height not to exceed 20 feet.
 3. 1/2 inch in 40 feet.
- B. Maximum variation from plumb for external corners, expansion joints, control joints and other conspicuous lines do not exceed:
1. 1/4 inch in 20 feet.
 2. 1/2 inch in 40 feet.
- C. For vertical alignment of head joints do not exceed:
1. $\pm 1/4$ inch in 10 feet.
 2. 1/2 inch maximum.
- D. Variation in level for bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines do not exceed:
1. 1/4 inch 20 feet.
 2. 1/2 inch in 40 feet or longer.
- E. Variation of linear building line for position shown in plan and related portion of columns, walls and partitions do not exceed:
1. 1/2 inch in 20 feet.
 2. 3/4 inch in 40 feet or more
- F. Variation in cross-sectional dimensions for columns and thickness of walls from dimensions shown do not exceed:
1. -1/4 inch nor +1/2 inch.
- G. Variation in mortar joint thickness:
1. Do not vary from bed joint thickness indicated by more than:
 - a. $\pm 1/8$ inch with a maximum thickness limited to 1/2 inch.
 2. Do not vary bed joint thickness from bed joint thickness of adjacent course by:
 - a. More than 1/8 inch.
 3. Do not vary from head joint thickness indicated by more than:
 - a. $\pm 1/8$ inch.
 4. Do not vary head joint thickness from adjacent head joint thickness:

- a. \pm 1/8 inch.

3.12 CUTTING AND FITTING

- A. Cut and fit for conduit, sleeves and other penetrations indicated on Drawings. Coordinate with other sections of work to provide correct size, shape and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where strength of masonry work may be impaired.

3.13 CLEANING

- A. Clean work under provisions of Section 01 70 00 – Execution and Closeout Requirements.
- B. Promptly remove excess wet mortar. Clean calcium silicate brick using materials and methods as recommended by brick manufacturer.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.14 MASONRY WASTE DISPOSAL

- A. Recycling: Undamaged, excess masonry materials are contractor's property and shall be removed from the project site.
- B. Excess masonry waste: Remove and legally dispose of masonry waste off Owner's property. Do not use as fill material.

END OF SECTION

SECTION 04 43 13 – MORTAR-PLACED STONE VENEER

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Limestone veneer.
- B. Anchorage, and accessories.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Section 05 50 00 – Metal Fabrications: Placement of loose steel lintels.

1.03 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 40 00 – Quality Requirements.
- C. Section 04 05 03 – Masonry Mortar and Grout: Mortar.
- D. Section 05 40 00 – Cold-Formed Metal Framing: Securing masonry anchors to metal stud framing.
- E. Section 06 10 53 – Miscellaneous Carpentry: Corrosion-resistant fasteners used to secure through wall flashing to treated wood nailers.
- F. Section 06 16 43 – Gypsum Sheathing: Glass-faced wall sheathing.
- G. Section 07 21 00 – Continuous Thermal Insulation: Board insulation installed in cavity.
- H. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Liquid membrane installed over glass-faced gypsum sheathing.
 - 1. Sealants used to seal masonry veneer anchors to the fluid applied membrane air barrier and penetrations of the fluid applied membrane air barrier by fasteners shall be compatible with fluid applied membrane air barrier specified in Section 07 27 26.
- I. Section 07 65 10 – Flexible Flashing: Installation of through wall flashing.
- J. Section 07 90 00 – Joint Protection: Rod and sealant at control and expansion joints and perimeter joints.

1.04 REFERENCES

- A. American Concrete Institute:
 - 1. ACI 530/ASCE 5/TMS 402 – Building Code Requirements for Masonry Structures. (Edition referenced in applicable building code.)
 - 2. ACI 530.1/ASCE 6/TMS 602 – Specifications for Masonry Structures. (Edition

referenced in applicable building code.)

B. ASTM International:

1. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A366 – Standard Specification for Commercial Steel (CS) Sheet, Carbon (0.15 Maximum Percent) Cold Rolled.
3. ASTM A1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low Alloy with Improved Formability, Solution Hardened, and Bare Hardenable.
4. ASTM A1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, For Concrete.
5. ASTM C568 – Standard Specification for Limestone Dimension Stone.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with current ACI 530/ASCE 5/TMS 402 and ACI 530.1/ASCE 6/TMS 602.

1.06 MOCK-UP

A. Construct a sample panel using the following materials:

1. Stone: Proposed color range, texture and bond.
2. Mortar.
3. Structural Backing.
4. Veneer Anchors.
5. Flashings and Sealing the Top of the Flashing.
6. Weep Vents.
7. Wall Insulation.
8. Air Barrier.
9. Vertical Expansion Joint with Sealant and Backer Rod.

B. Locate where directed.

C. Mock-up may not remain as part of the work.

D. Do not start work until Architect has accepted sample panel.

E. Use panel as standard of comparison for all masonry work built of the same material.

F. Do not destroy or move panel until work is completed and accepted by the Owner.

G. Mock up Notes

Phase One: Construct mock up using the following materials:

1. Metal stud back up.
2. 1/2 -inch sheathing at metal stud back up.
3. Wood nailers around the perimeter of the window frame.
4. Air barrier material.
5. Window frame with glass.
6. Flashing window frame to air barrier membrane.
7. Loose lintel.
8. Through wall flashing at base of wall and above window head.
9. Masonry ties.
10. Board Insulation: Installed on half of the mock up.

Phase Two: After the mock up has been reviewed and approved install the following materials.

1. Sealants around the perimeter of the window frame and vertical control joint.

1.07 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures. Obtain written acceptance of submittals prior to the purchase of the materials or methods.
- B. Product Data: Provide data for fabricated ties and anchors, and accessories as specified.
- C. Samples: Provide five individual stone samples of each color specified to illustrate color, texture and extreme color range.
- D. Certificates: Submit certificates attesting compliance with applicable specifications for grades, types and classes included in these specifications.
- E. Hot and cold weather construction procedures for meeting the requirements of these specifications.

1.08 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 530 and ACI 530.1.
- B. Installer: Company specializing in performing work of this section with minimum five years

of documented experience.

- C. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry or stone fabricator with resources to provide materials of consistent quality in appearance and physical properties.

1.09 PRE-INSTALLATION CONFERENCE

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Convene minimum four weeks prior to commencing work of this section, at the project site. Give four weeks advance notice to the participants, including the contractor, mason contractor and flashing installer. Advise the Architect of the scheduled meeting date.

1.10 JOB CONDITIONS

- A. Protection of Work.
 - 1. Wall Covering:
 - a. During erection, cover top of wall with strong waterproof membrane at end of each day or shutdown.
 - b. Cover partially completed walls when work is not in progress.
 - c. Extend cover minimum 24 inches down sides, and hold cover securely in place.
- B. Protection of Flexible Flashing Membrane.
 - 1. Protect flexible flashing membrane from damage. Prior to installing masonry, inspect flashing for any damage including punctures, tears or loose scrim. Immediately notify contractor of any damage to flexible flashing. Do not proceed with work until flashing has been repaired or replaced in accordance with flexible flashing manufacturer's instructions.
- C. Staining:
 - 1. Prevent grout or mortar from staining the face of stone to be left exposed.
 - a. Remove immediately grout or mortar in contact with face of such stone.
 - b. Protect all sills, ledges and projections from droppings of mortar; protect door jambs and corners from damage during construction.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 – Product Requirements.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Hot and Cold Weather Requirements: Follow requirements for cold and hot weather construction in ACI 530.1/ASCE6/TMS 602 specifications for masonry structures.

1.13 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and Project Requirements.
- B. Coordinate masonry work with installation of window and door anchors.

PART 2 PRODUCTS

2.01 MANUFACTURERS – STONE

- A. U.S. Stone Industries, LLC
 - 1. Stone type: Top Ledge Cottonwood

2.02 STONE FABRICATION

- A. Nominal Thickness: 3 5/8 inches. NOTE: Thickness of stone shall not exceed 3 5/8 inches.
- B. Size:
 - 1. Length: 23 5/8 inches.
 - 2. Height: 15 5/8 inches.
- C. Finish: Honed.
- D. Pattern and Coursing: Running bond
- E. Fabricate for 3/8 inch bed and head joints.

2.03 ANCHORAGE

- A. Adjustable Masonry Veneer Anchors
 - 3. Provide two-piece assemblies for attachment over sheathing to metal studs and/or concrete/concrete block.
 - a. Anchor: Anchor system for stone veneer to metal stud, concrete block and/or concrete shall consist of the following:
 - 1) Back Plate: Provide 14- gauge plate unless 12 -gauge is required based on wind loads and anchor spacing.
 - 2) Size: Based on insulation thickness specified in Section 07 21 00 – Continuous Thermal Insulation.
 - 3) Sheet metal shall conform to ASTM A1008. Anchor shall be hot-dip galvanizing after fabrication conforming to ASTM A153 Class B2, (1.5 oz./ft²).
 - 4) Products: HB-213 by Hohmann & Barnard.
 - 5) Products: HB-5213 by Hohmann & Barnard for anchoring to concrete block and/or concrete.
 - b. Tie: Provide masonry wire tie (pintle) fabricated from cold-drawn steel wire 3/16inch diameter conforming to ASTM A1064 (tensile strength). Hot-dip galvanizing after fabrication shall conform to ASTM A153 Class B2.

- Provide length of tie as required to provide a minimum of 2- inch embedment into the stone bed joint with minimum 5/8- inch mortar cover.
- c. Steel drill screws for steel studs:
 - 1) Self-drilling self-tapping screws; hex washer head, size #10, lengths required to penetrate steel stud flange by not less than 3 exposed threads.
 - 2) Organic polymer coated with salt-spray resistance to red rust of more than 800 hours per ASTM B117.
 - 3) Provide neoprene sealing washers.
 - d. Expansion anchors for concrete and masonry:
 - 1) Hohmann and Barnard BL-523 Brass Expansion Bolt.
2. Substitutions permitted in accordance with Section 01 60 00 – Product Requirements.
1. Substitutions permitted in accordance with Section 01 60 00 – Product Requirements.

2.04 MORTAR AND GROUT

- A. Mortar and Grout: As specified in Section 04 05 03 – Masonry Mortar and Grout.

2.05 FLEXIBLE FLASHINGS

- A. Coordinate with Section 07 65 10 – Flexible Flashing.

2.06 ACCESSORIES

- A. Joint Filler: Closed-cell neoprene sponge conforming to ASTM D1056, 3-inch-wide, 3/8 inch and 1 inch thick as manufactured by Hohmann and Barnard, Inc. or approved equivalent.
- B. Lintels: Steel lintels shall be hot-dip galvanized ASTM A36 and painted.
- C. Weep Vents: Quadro-Vent #QV 3/8 inch by 2-1/2 inch by 3-3/8 -inch weep vents as manufactured by Hohmann & Barnard, Color: White, or approved equivalent.
- D. Cleaning Solution: Approved by stone manufacturer. Cleaning solution shall not be harmful to stone work or adjacent material.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify that field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.

- D. Verify built-in items are in proper location and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied by other sections.
- B. Furnish temporary bracing during installation of stone work. Maintain in place until building structure provides permanent bracing.
- C. Mix units for exposed stone from several pallets or cubes as they are placed to produce uniform blend of colors and textures.
- D. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint widths and for accurate locating of openings, movement type joints, returns and offsets.
- E. Clean stone prior to erection. Do not use wire brushes or implements that mark or damage exposed surfaces.

3.03 INSTALLATION

- A. Cut stone at site to produce clean faces.
- B. Size stone units to fit opening dimensions and perimeter conditions.
- C. Wet absorptive stone in preparation for placement to minimize moisture suction from mortar.
- D. Arrange stone pattern in color uniformity and minimize visual variations, and in uniform blend of stone unit sizes.
- E. Arrange stone coursing in running bond with consistent joint width.
 - 1. Stone shall be coursed to match spacing of the masonry ties per Article 3.06 of this section.
- F. Set stone in full mortar setting bed and with full head joints.

3.04 WEEP VENTS

- A. Install weep vents in head joints in exterior wythes at 24 inches on center horizontally above through-wall flashing, above lintels and at bottom of walls. Above window and door openings install weep vents at 16 inches on center. Install weep vents at top of walls spaced at 24 inches on center.
 - 1. All weep vents installed in conjunction with through-wall flashing shall be placed directly on top of the horizontal surface of the through-wall flashing. Do not place on top of the mortar bed joint at this location.

3.05 CAVITY BEHIND VENEER

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weeps.
- B. Slope beds toward cavity to minimize mortar protrusions into cavity. As work progresses,

trowel mortar fins protruding into cavity flat against cavity face of stone.

3.06 REINFORCEMENT AND ANCHORAGE

- A. Secure wall ties to stud framed back-up and embed into stone veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Install additional anchors within 12 inches of all openings larger than 16 inches in either direction and at intervals around the perimeter not exceeding 16 inches on center each way.
1. Install wall ties after fluid applied air barrier membrane is installed.
 - a. Coat back of anchor plate with sealant compatible with fluid applied air barrier membrane.
 2. Screw-attach veneer anchor to stud face; ensure full contact of veneer anchor to sheathing. Provide two screws per anchor.
 3. Install masonry wall tie (pintle) at each veneer anchor location; install ties as exterior wythe of stone construction progresses. The legs of the pintle shall properly engage the back plate. **DO NOT INSTALL THE TIE BEYOND THE ALLOWABLE LIMITS OF ECCENTRICITY.**
- B. Secure wall ties to concrete block back-up and/or concrete and embed into stone veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Install additional anchors within 12 inches of all openings larger than 16 inches in either direction and at intervals around the perimeter not exceeding 16 inches on center each way.
1. Install wall ties after fluid applied air barrier membrane is installed.
 - a. Coat back of anchor plate with sealant compatible with fluid applied air barrier membrane.
 - b. Prior to installing expansion bolt fill drilled hole in concrete block and or concrete with sealant.
 2. Attach veneer anchor to masonry or concrete surface using expansion bolts for masonry/concrete; ensure full contact of veneer anchor to face of wall surface. Provide one bolt per anchor.
 3. Install masonry wall tie (pintle) at each veneer anchor location; install ties as exterior wythe of stone construction progresses. The legs of the pintle shall properly engage the back plate. **DO NOT INSTALL THE TIE BEYOND THE ALLOWABLE LIMITS OF ECCENTRICITY.**
- C. At vertical expansion and control joints, install additional anchors within 8 inches of joint at 16 inches on center vertically.
- D. At stone sills, secure stone to back-up framing with veneer anchors spaced at 16 inches on center. Seal all penetrations in through-wall flashing made by fasteners. Fasteners used to install anchors shall be compatible with stainless steel.

3.07 FLEXIBLE MASONRY FLASHINGS

- A. Coordinate with Section 07 65 10 – Flexible Flashing.

3.08 LINTELS

- A. Install loose steel lintels over openings and where shown on drawings.
- B. Maintain minimum 8- inch bearing on each side of opening.

3.09 EXPANSION JOINTS

- A. Install expansion joints at the following locations, unless otherwise indicated on Drawings:
 - 1. Exterior Walls: 20 feet on center and within 24 inches on each side of inside and outside corners.
 - 2. At changes in wall height.
 - 3. On one side of openings up to 6'-0" wide. At openings over 6'-0" wide provide joints on each side of opening.
 - 8. At offset and setbacks.
- B. Do not install adjustable stone veneer anchors through expansion joints.
- C. Install joint filler in continuous lengths. Set face of joint filler 1-1/2 inch in from outside face of stone.
- D. Size expansion joint in accordance with Section 07 90 00 for sealant performance.

3.10 CUTTING AND FITTING

- A. Cut and fit for conduit, sleeves and other penetrations indicated on Drawings. Coordinate with other sections of work to provide correct size, shape and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where strength of masonry work may be impaired.

3.11 CLEANING

- A. Clean work under provisions of Section 01 70 00 – Execution and Closeout Requirements.
- B. Promptly remove excess wet mortar from the face of the stone as work progresses. Do not use strong acids, overaggressive sandblasting or high-pressure cleaning methods.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.12 MASONRY WASTE DISPOSAL

- A. Recycling: Undamaged, excess stone materials are contractor's property and shall be removed from the project site.

- B. Excess Stone Waste: Remove and legally dispose of masonry waste off Owner's property. Do not use as fill material.

END OF SECTION

SECTION 04 72 00 – CAST STONE MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Cast stone sills
 - 2. Cast stone copings.
 - 3. Cast stone column caps
 - 4. Anchors and supports.
 - 5. Accessories.

1.02 RELATED SECTIONS

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Section 01 33 00 – Submittal Procedures.
- C. Section 04 05 03 – Masonry Mortaring and Grouting: Mortar for setting cast stone units.
- D. Section 04 20 00 – Unit Masonry: Securing cast stone copings/caps to concrete block with threaded dowel pins.
- E. Section 04 20 19 – Veneer Unit Masonry: Installing cast stone sills.
- F. Section 04 43 13-Mortar-Placed Stone Veneer: Installing cast stone products as part of the mortar-placed stone assembly.
- G. Section 05 40 00 – Cold-Formed Metal Framing: Backup for cast stone veneer.
- H. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Air barrier placed behind cavity wall insulation.
- I. Section 07 65 10 – Flexible Flashing: Installation of through wall flashing.
- J. Section 07 90 00 – Joint Protection: Rod and sealant at joints.

1.03 REFERENCES

- A. ASTM International:
 - 1. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 2. ASTM A185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.

3. ASTM A615/A615M – Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
5. ASTM A666 – Standard Specification for Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
6. ASTM C1064 – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
7. ASTM C33 – Standard Specification for Concrete Aggregates.
8. ASTM C39/C39M – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
9. ASTM C150 – Standard Specification for Portland Cement.
10. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volume Method.
11. ASTM C231 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
12. ASTM C260 – Standard Specification for Air-Entrained Admixtures for Concrete.
13. ASTM C270 – Standard Specification for Mortar for Unit Masonry.
14. ASTM C426 – Standard Test Method for Linear Shrinkage of Concrete Masonry Units.
15. ASTM C494/C494M – Standard Specification for Chemical Admixtures for Concrete.
16. ASTM C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
17. ASTM C642 – Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.
18. ASTM C666 – Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
19. ASTM C979 – Standard Specification for Pigments for Integrally Colored Concrete.
20. ASTM C989 – Standard Specification for Slag Cement for Use in Concrete and Mortars.
21. ASTM C1194 – Standard Test Method for Compressive Strength of Architectural Cast Stone.
22. ASTM C1195 – Standard Test Method for Absorption of Architectural Cast Stone.

23. ASTM C1364 – Standard Specification for Architectural Cast Stone.
24. ASTM D2244 – Standard Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.

B. The Masonry Society:

1. TMS MSJC – Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402), Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602) and Commentaries. (Edition referenced by applicable building code.)

C. Cast Stone Institute:

1. Technical Manual, current edition.

1.04 DEFINITIONS

A. Cast Stone: A refined architectural concrete building unit manufactured to simulate natural cut stone, used in unit masonry applications.

1. Dry Cast Concrete Products: Manufactured from zero slump concrete.
 - a. Vibrant Dry Tamp (VDT) Casting Method: Vibratory ramming of earth moist, zero-slump concrete against a rigid mold until it is densely compacted.
 - b. Machine Casting Method: Manufactured from earth moist, zero-slump concrete compacted by machinery using vibration and pressure against a mold until it becomes densely consolidated.
2. Wet Cast Concrete Products – Manufactured from measurable slump concrete.
 - a. Wet Casting Method: Manufactured from measurable slump concrete and vibrated into a mold until it becomes densely consolidated.

1.05 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Requirements for Submittals.

B. Shop Drawings:

1. Indicate cast-stone layout, profiles, cross-sections, reinforcement, exposed faces, joint arrangement, anchoring methods, anchors, annotation of stone types and their location.
2. Indicate cast-stone types and location.

C. Product Data: Submit data for cast stone units, wall ties, anchors, and other accessories.

D. Samples:

1. Submit four of each cast stone item, 12 by 12 inches in size illustrating profiles, finish, texture and color range.

2. Submit four of each anchor and illustrating material, configuration, and finish.
 - E. Test Reports: Indicate concrete mix design compressive strength and water absorption.
 - F. Manufacturer's Installation Instructions: Submit instructions for anchor attachment, cast stone cleaning, and special Project installation conditions.
 - G. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- 1.06 QUALITY ASSURANCE
- A. Perform Work in accordance with Cast Stone Institute Technical Manual.
 - B. Perform Work in accordance with ACI 530 Building Code Requirements for Masonry Structures and ACI 530.1 Specification for Masonry Structures.
- 1.07 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum five years of documented experience.
 1. Manufacturer shall have sufficient plant facilities to produce the shapes, quantities and size of cast stone required in accordance with the project schedule.
 - B. Installer: Company specializing in performing work of this section with minimum five years of documented experience approved by manufacturer.
- 1.08 MOCK-UP
- A. Section 01 40 00 – Quality Requirements: Requirements for mock-up.
 - B. Provide full-sized units to be incorporated into mock-up wall specified in Section 04 20 19 and 04 43 13.
 - C. Locate where directed by Architect/Engineer.
 - D. Remove mock-up when directed by Architect/Engineer.
- 1.09 PRE-INSTALLATION MEETINGS
- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
 - B. Convene minimum four weeks prior to commencing work of this section.
- 1.10 JOB CONDITIONS
- A. Protection of Work.
 1. Wall Covering:
 - a. During erection, cover top of wall with strong waterproof membrane at end of each day or shutdown.

- b. Cover partially completed walls when work is not in progress.
- c. Extend cover minimum 24 inches down sides, and hold cover securely in place.

B. Protection of Flexible Flashing Membrane.

- 1. Protect flexible flashing membrane from damage. Prior to installing masonry, inspect flashing for any damage including punctures, tears or loose scrim. Immediately notify contractor of any damage to flexible flashing. Do not proceed with work until flashing has been repaired or replaced in accordance with flexible flashing manufacturer's instructions.

C. Staining:

- 1. Prevent grout or mortar from staining the face of stone to be left exposed.
 - a. Remove immediately grout or mortar in contact with face of such stone.
 - b. Protect all sills, ledges and projections from droppings of mortar; protect corners from damage during construction.

1.11 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept cast stone on site in manufacturer's protective packaging. Inspect for damage.
- C. Store cast stone on site covered and elevated above grade. Protect cast stone from damage, soiling, and staining.
- D. Provide ventilation to prevent condensation from forming on cast stone.

1.12 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements: Environmental conditions affecting products onsite.
- B. Cold Weather Requirements: In accordance with ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F (4 degrees C).
- C. Hot Weather Requirements: In accordance with ACI 530.1 when ambient temperature is greater than 100 degrees F (38 degrees C) or ambient temperature is greater than 90 degrees F (32 degrees C) with wind velocity greater than 8 mph (13 km/h).

1.13 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.14 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Requirements for Coordination.
- B. Coordinate cast stone work with veneer masonry, metal framed backup

PART 2 PRODUCTS

2.01 CAST STONE

- A. Product Description: ASTM C1364, architectural cast stone units fabricated by either dry casting or wet casting methods, with fine grained texture, simulating natural cut stone.
- B. Color and Finish:
 - 1. Color:
 - a. To be selected by Architect.
 - 2. All surfaces intended to be exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 inch and the density of such voids shall be less than three occurrences per any 1 in.² and not obvious under direct daylight illumination at a 5-foot distance.
 - 3. Units shall exhibit a texture approximately equal to the approved sample when viewed under direct daylight illumination at a 10-foot distance.
 - a. ASTM D2244 permissible variation in color between units of comparable age subjected to similar weathering exposure.
 - 1) Total color difference – not greater than six units.
 - 2) Total hue difference – not greater than two units.

2.02 COMPONENTS

- A. Portland Cement: Type I or Type III; white; ASTM C150.
- B. Coarse Aggregates: Granite, quartz or limestone; ASTM C33; except for gradation; and are optional for the VDT casting method.
- C. Fine Aggregates: Manufactured or natural sands; ASTM C33; except for gradation.
- D. Colors: Inorganic iron oxide pigments; ASTM C979; except that carbon black pigments shall not be used.
- E. Admixtures: Comply with the following:
 - 1. ASTM C260 for air-entraining admixtures.
 - 2. ASTM C494/C 494M Types A-G for water reducing, retarding, accelerating and high range admixtures.
 - 3. Other admixtures: Integral water repellents and other chemicals, for which no ASTM Standard exists, shall be previously established as suitable for use in concrete by proven field performance or through laboratory testing.
 - 4. ASTM C618 mineral admixtures of dark and variable colors shall not be used in surfaces intended to be exposed to view.

5. ASTM C989 granulated blast furnace slag may be used to improve physical properties. Tests are required to verify these features.
- F. Water: Potable.
- G. Reinforcing Bars:
1. ASTM A 615/A 615M. Grade 40 or 60 steel galvanized or epoxy coated when cover is less than 1.5 inches.
 2. Welded Wire Fabric: ASTM A1064 where applicable for wet cast units.

2.03 ACCESSORIES

- A. Anchors and Supports: Stainless steel, ASTM A666, Type 302 or 304.
1. Sizes and Configurations: As required for vertical and horizontal support of cast stone.
 2. Cast stone sills: Hohmann and Barnard.
 - a. At ends of sills, #432 pin strap anchor, minimum 1/8 inch thick with 1/2 inch diameter dowels.
 - b. Between sills, #433 split dowel anchor, minimum 1/8 inch thick with 1/2 inch diameter dowels.
- B. Threaded Dowel Pin: Hohmann & Barnard #407, 1/2 inch diameter by 4 inches long unless otherwise noted made from stainless steel threaded rod Type 304.
- C. Mortar: As specified in Section 04 05 03.
1. Type N
 2. Color: Match cast stone units.
- D. Flashings: Section 07 65 10 – Flexible Flashing.
- E. Sealant: Type specified in Section 07 90 00, color to match cast stone color.
- F. Weep Vents: Quadro-Vent #QV 3/8 inch by 2-1/2 inch by 3-3/8- inch weep vents as manufactured by Hohmann & Barnard, Color: White, or approved equivalent.
- G. Cleaning Solution: As recommended by cast stone manufacturer.
- H. High density stone shims: MasonPro 3/8 inch by 2 inch by 2 inch high density plastic shims with compressive strength of 10,000 to 12,000 psi.

2.04 MIXES

- A. Comply with ASTM C1364.
- B. Physical properties: Provide the following:

1. Compressive Strength – ASTM C1194, Method C: 6,500 psi minimum for products at 28 days.
2. Absorption, Cold Water – ASTM C1195, Method A: 6 percent maximum at 28 days.
3. Air Content – ASTM C173 or C231: Provide sufficient air content to meet freeze-thaw requirements for wet cast products when air content is tested in accordance with Test Method C173 or Test Method C231. Air entrainment is not required for VDT products.
4. Freeze-thaw – ASTM C666 in accordance with ASTM C1364: The CPWL shall be less than 5 percent after 300 cycles of freezing and thawing.
5. Linear Drying Shrinkage – ASTM C426: Test and report in accordance with ASTM C1364.
6. Slump: No measurable slump for dry casting method.

2.05 FABRICATION

- A. Size and thickness: As indicated on Drawings.
- B. Use rigid molds, constructed to maintain cast stone units uniform in shape, size and finish.
- C. Form units to length required for joint layout indicated on Drawings. Field cutting to length is not permitted.
- D. Reinforce units in accordance with ASTM C1364 for safe handling and as indicated on shop drawings to resist structural loads.
 1. Minimum reinforcing shall be 0.25 percent of the cross-section area.
 2. Reinforcement shall be noncorrosive where faces exposed to weather are covered with less than 1.5 inches of concrete material. All reinforcement shall have minimum coverage of twice the diameter of the bars.
 3. Cast stone units greater than 24 inches in one direction shall be reinforced in that direction. Units less than 24 inches in both their length and width dimension shall be non-reinforced unless otherwise specified.
 4. Welded wire fabric reinforcing shall not be used in dry cast products.
- E. Embed anchors and other cast-in items.
- F. Form external corners to square joint profile.
- G. Slope exposed top surfaces of horizontal sills, copings, column caps surfaces for natural wash.
- H. Form drip slot in bottom surface of exterior units projecting more than 1/2 inch beyond face of wall. Size slot not less than 3/8- inch wide and 1/4 -inch deep; full width of projection.
- I. Curing: Cure units in a warm curing chamber approximately 100 degrees F at 95 percent

relative humidity for approximately 12 hours, or cure in a 95 percent moist environment at a minimum 70 degrees F for 16 hours after casting. Additional yard curing at 95 percent relative humidity shall be 350 degree-days (i.e. 7 days @ 50 degrees F or 5 days @ 70 degrees F) prior to shipping. Form cured units shall be protected from moisture evaporation with during blankets or curing compounds after casting.

- J. Remove cement film, if required, to achieve uniform appearance.

2.06 SOURCE QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Testing, inspection and analysis requirements.
- B. Maintain plant records and quality control program during production of cast stone units. Make records available upon request.
- C. Test and analyze three random specimens for each 500 cubic feet of fabricated cast stone units:
 - 1. Compressive Strength: In accordance with ASTM C1194.
 - 2. Cold Water Absorption: In accordance with ASTM C1195.
- D. Inspect and test for color variation.
- E. Test samples in accordance with ASTM D2244 for the following:
 - 1. Total Color Variation: In accordance with ASTM C1364. Not greater than 6 units.
 - 2. Total Hue Variation: In accordance with ASTM C1364. Not greater than 2 units.
- F. Make completed cast stone available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least seven days before inspection is allowed.
- G. Allow witnessing of factory inspections and test at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.

2.07 MANUFACTURING TOLERANCES

- A. Cross-section dimensions shall not deviate by more than $\pm 1/8$ inch from approved dimensions.
- B. Length of units shall not deviate by more than length/360 or $\pm 1/8$ inch, whichever is greater, not to exceed $\pm 1/4$ inch.
 - 1. Maximum length of any unit shall not exceed 15 times the average thickness of such unit unless otherwise agreed by the manufacturer.
- C. Warp, bow or twist of units shall not exceed length/360 or $\pm 1/8$ inch, whichever is greater.
- D. Location of dowel holes, anchor slots, false joints and similar features – on formed sides of unit, $1/8$ inch; on unformed sides of unit, $3/8$ - inch maximum deviation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.

3.02 PREPARATION

- A. Coordinate installation of anchors furnished to other sections.

3.03 INSTALLATION

- A. Establish lines, levels and coursing indicated. Protect from displacement.
- B. Maintain cast stone courses to uniform dimension. Form bed and head joints of uniform thickness.
- C. Cast Stone Coursing:
 - 1. Joint Location: As indicated on Shop Drawings.
 - 2. Joint width at stone to brick or stone to stone veneer units: 3/8 inch.
 - 3. Joint width at stone to stone: 3/8 inch.
 - 4. Stone to stone joints exposed on top: 3/8 inch.
- D. Placing and Bonding:
 - 1. Wet cast stone units with clear running water, just prior to setting.
 - 2. Install anchors to support and position cast stone.
 - 3. Threaded dowel pins: Drill hole in grout filled concrete block 1/2 inch larger than diameter of pin and depth as shown on drawings. Fill hole with non-shrink grout and insert pin. Space pins in accordance with cast stone shop drawings. Provide a minimum of two pins per piece of stone coping column cap. Seal around penetration in flashing with sealant specified in Section 07 65 10.
 - 4. Lay cast stone units in full bed of mortar at all bed joints.
 - 5. Stone sills, copings, column caps: Leave all exposed tops and head joints open to receive backer rod and sealant.
 - 6. At cast stone copings and column caps anchored to concrete block install 3/8-inch shims under cast stone copings and caps. Space shims at maximum 24 inches on center.

7. Fill all dowel holes with mortar or non-shrink grout.
 8. Do not shift or tap cast stone units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
 9. Site cutting of cast stone units is not permitted.
- E. Weep vents:
1. At stone sills install weep vents in the horizontal position at 24 inches on center. Provide a minimum of two weep vents per sill.
 2. All weep vents installed in conjunction with through wall flashing shall be placed directly on top of the horizontal surface of the through wall flashing. Do not place on top of the mortar bed joint at this location.
- F. Cavity Wall: Do not permit mortar to drop or accumulate into cavity air space or to plug weeps. Build backup masonry wythe ahead of cast stone veneer to receive cavity insulation and air/vapor retarder adhesive.
- G. Through Wall Flashing: Install in accordance with Section 07 65 10 – Flexible Flashing.
- H. Control and Expansion Joints:
1. Install preformed control joint device in continuous lengths. Seal butt and corner joints.
 2. Size control joint in accordance with Section 07 90 00 for sealant performance.
 3. Form expansion joint as indicated on Drawings.

3.04 ERECTION TOLERANCES

- A. Section 01 40 00 – Quality Requirements: Tolerances.
- B. Maximum Variation of Joint Thickness: Plus 1/16 inch; minus 1/8 inch.
- C. Maximum Offset from Adjacent Unit: 1/8 inch.
- D. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
- E. Maximum Variation from Plumb: 1/4 inch in each story non-cumulative; 1/2 inch in two stories or more.
- F. Maximum Variation from Level Coursing: 1/8 inch in 3 feet (3 mm/m) and 1/4 inch in 10 feet (6 mm/3 m); 1/2 inch in 30 feet (13 mm/9 m).

3.05 CLEANING

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove excess mortar and sealant as work progresses.

- C. Replace defective mortar. Match adjacent work.
- D. Wet cast stone. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.06 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect cast stone from contact with mortar, soil and other materials capable of staining or discoloring cast stone.

END OF SECTION

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Structural steel framing members and connections.
2. Deck support angles.
3. Shop welded shear studs.
4. Shop prime painting and touch up painting in field.
5. Temporary construction bracing.
6. Fabrication and erection inspection and testing.
7. Grout under baseplates and bearing plates.

- B. Related Sections:

1. Division 1 Section "Sustainable Project Design Requirements" for LEED standards and project requirements.
2. Division 1 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
3. Division 5 Section "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
4. Division 5 Section "Steel Decking" for field installation of shear connectors through deck.
5. Division 5 Section "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other metal items not defined as structural steel.
6. Division 5 Section "Metal Stairs."
7. Division 9 Section "Exterior Painting", Division 9 Section "Interior Painting", and Division 9 Section "High-Performance Coatings" for surface-preparation and priming requirements.
8. Division 13 Section "Metal Building Systems" for structural steel.

1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
 - 2. Use LRFD; data are given at factored-load level.
- B. Moment Connections: Type FR, fully restrained.
- C. Construction: Braced frame.

1.5 ACTION SUBMITTALS FOR REVIEW

- A. Shop Drawings: Provide complete details and schedules for fabrication and shop assembly of steel members, erection plans, details, procedures, and diagrams showing sequence of erection of structural steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
 - 5. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Shop drawings and erection drawings shall not be made by using reproductions of Contract Drawings.
- C. Structural steel members for which shop drawings have not been reviewed shall not be fabricated. Engineer's review shall cover general locations, member spacing, and details of design. Omission from shop drawings of any materials required by the Contract Documents shall not relieve the Contractor of the responsibility to furnish and install such materials, even though such shop drawings may have been reviewed.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Structural Steel Connection Calculations: For each type of connection not specifically detailed on the Contract Drawings, submit connection details, design loads, and calculations signed and sealed by the qualified professional engineer responsible for their preparation. Submit design calculations prior to or with the steel shop drawings. Shop drawings containing connections for which calculations have not been submitted shall be returned unchecked as an incomplete submittal. Calculations will be retained for the Engineer's record purposes and will not be approved or returned.

1. Connections shall be designed in accordance with the requirements specified in the Structural Drawings and Specifications.
 2. Beam connections not covered by Contract Drawings: Submit a complete calculation for each different beam connection used and detailed on the shop drawings. Conditions which are similar may be grouped together so as to utilize a single connection design.
 3. Submit complete connection calculations for wind brace connections, truss connections, moment connections and other connections where specified on the Contract Drawings. Each calculation shall identify the location or locations for which the connection applies, the member mark(s) from the Contract Documents, the piece mark(s) from the shop drawings, the member size, the design loading(s), member size, and the end of the member to which the connection applies.
- C. Qualification Data: For qualified Installer, fabricator, and testing agency.
- D. Welding certificates.
- E. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- F. Mill test reports for structural steel, including chemical and physical properties.
- G. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength bolt-nut-washer assemblies.
 4. Shear stud connectors.
 5. Shop primers.
 6. Nonshrink grout.
- H. Source quality-control reports.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 10 years documented experience.
- C. Shop-Painting Applicators: Qualified according to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- E. The latest adopted edition of all standards referenced in this Section shall apply unless noted otherwise. In case of conflict between these Contract Documents and the referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

- F. The Contractor shall furnish fabrication and erection inspection and testing of all welds in accordance with AWS D1.1, Chapter 6. Submit records of inspections and tests to the Owner's testing laboratory for their review. The fabrication and erection inspectors shall be AWS certified welding inspectors.
- G. All materials, fabrication procedures and field erection are subject to verification inspection and testing by the Owner's testing laboratory in both the shop and field. Such inspections and tests will not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with specified requirements.
- H. Qualifications for Welding Work: Contractor shall be responsible for qualifying welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification to Owner's testing laboratory that welders to be employed in the work have satisfactorily passed AWS qualification tests. Recertification of welders shall be Contractor's responsibility.
- I. Qualification of Welding Procedures: Contractor shall provide the testing laboratory with welding procedures which are to be used. Welding procedures shall be qualified prior to use in accordance with AWS D1.1, Part B.
- J. Comply with applicable provisions of the following specifications and documents:
 - 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges" except that the following sentence in paragraph 4.2.1 shall not apply: "This approval constitutes the Owner's acceptance of all responsibility for the design adequacy of any detail configuration of connections developed by the fabricator as part of his preparation of these shop drawings.
 - 2. AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings."
 - 3. ASTM A6 "Specifications for General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
 - 4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 - 5. AISC's "Specification for Load and Resistance Factor Design of Single-Angle Members."
 - 6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - 7. AWS D1.1 "Structural Welding Code"
 - 8. SSPC (Steel Structures Painting Council), Painting Manuals, Volumes 1 and 2.
 - 9. UL "Fire Resistance Directory."
- K. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.

2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
 1. W-Shapes: 60 percent.
 2. Channels, Angles, S-Shapes: 60 percent.
 3. Plate and Bar: 25 percent.
 4. Cold-Formed Hollow Structural Sections: 25 percent.
 5. Steel Pipe: 25 percent.
 6. All Other Steel Materials: 25 percent.
- B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- C. Materials complying with first and second options in first paragraph below are widely available. Third and fourth options include specialty-steel materials; verify availability if required.
- D. Domestic Steel: All steel shall be domestically manufactured, unless foreign sources are specifically accepted by the Owner.
- E. W-Shapes: ASTM A 992/A 992M.
- F. Channels, Angles, S-Shapes: ASTM A 36/A 36M.
- G. Plate and Bar: ASTM A 36/A 36M, ASTM A 572/A 572M, Grade 50.
- H. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- I. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.

1. Weight Class: As indicated.
2. Finish: Black except where indicated to be galvanized.

J. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish. Direct-Tension Indicators shall be "Load Indicator Washers" as manufactured by Bethlehem Steel Corporation.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM 1852, Type 1, heavy hex or round head steel structural bolts with splined ends; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers. Tension control bolts shall be as manufactured by the LeJeune Bolt Company, Lakeville, Minnesota or Lohr Structural Fasteners, Inc., Humble, Texas. Tension control bolts may be used at the contractor's option in lieu of conventional high-strength bolts.

1. Finish: Plain.

D. Shear Connectors: ASTM A 108, Grades 1010 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Headed Anchor Rods: ASTM A307 or ASTM F 1554, Grade 36, weldable, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain.

F. Threaded Rods: ASTM A 36/A 36M unless noted otherwise.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

G. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

H. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

- I. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.3 PRIMER

- A. VOC Content: All paints and coatings applied to building interior shall meet limits of SCAQMD r1113. Rust preventive coatings shall meet limits of GC-03.
- B. Primer: Comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- D. Galvanizing Repair Paint: ASTM A 780.

2.4 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time, capable of developing a minimum compressive strength of 5,000 psi at 28 days.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
 1. Camber: Provide camber to structural-steel members where indicated. Specified camber applies to steel member prior to erection at jobsite, lying flat so that member weight has no effect. Take necessary precautions to prevent or compensate for camber loss during shipment. Measured camber in members up to 50'-0" long shall be within a tolerance of minus 1/2" to plus zero from the amount specified. For members greater than 50'-0" long, both the positive and negative tolerance may increase 1/8" for every 10'-0" of length in excess of 50'-0". Members with field measured camber outside of the specified tolerance shall be returned to the shop.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces. Mechanical thermal cutting is not allowed without approval by Engineer.

- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1 "Solvent Cleaning or SSPC-SP 2, "Hand Tool Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural steel. Straighten as required to provide uniform, square, and true members in completed wall framing.
- H. Welded Door Frames: Build up welded door frames attached to structural steel. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened unless noted or approved otherwise.
 - 2. Provide ASTM F436 washer over all short slotted holes in an outer ply.
 - 3. Provide 5/16" thick structural grade plate washer over all long slotted holes in an outer ply.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces to be high-strength bolted with slip-critical connections.

4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces.
 6. Surfaces of high strength, low alloy steel members (weathering steel).
 7. Top surfaces of beams which support composite metal floor deck.
 8. Headed shear studs, although overspray is acceptable.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
 3. SSPC-SP 7/NACE No. 4, "Brush-Off Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
 6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
 9. SSPC-SP 8, "Pickling."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.
- E. Painting: Remove any visible rust that forms on blast cleaned surfaces prior to coating application by reblasting visibly rusted areas in conformance with SSPC SP-6. Immediately after surface preparation, apply structural steel primer paint in accordance with manufacturer's instructions and at a rate to provide a uniform dry film thickness of not less than 2.5 dry mils.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Hot-Dip galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls along with all associated fasteners.

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in

intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not field cut or alter structural members without approval by Architect/Engineer.
- G. Do not use thermal cutting during erection unless approved by Architect/Engineer. Where allowed, finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- H. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- I. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

- J. Slide Bearings: Slide bearing plates shall be permanently affixed to the member and support by welding. Member faces shall be aligned and leveled so as to maintain contact between surfaces before installing bearing plates.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened.
 - 2. A307 bolts and high-strength (A325 and A490) bolts noted to be "snug-tight" shall be tightened using a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench, bringing the plies into contact.
 - 3. High-strength bolts which are not specifically designated to be "snug-tight" shall be tightened to provide at least the minimum tension shown in Table 4 of the "Specification for Structural Joints using ASTM A325 and A490 Bolts." Tightening shall be done by the turn-of-the-nut method, with direct tension indicators, or by properly calibrated wrenches.
 - 4. Faying surfaces of "slip-critical" connections, as defined in the "Specification for Structural Joints" and indicated on the Drawings shall have all paint removed by blast cleaning.
 - 5. Bolts tightened with a calibrated wrench or by torque control shall have a hardened washer under the element (nut or bolt head) turned in tightening.
 - 6. Hardened washers shall be placed over slotted holes in an outer ply. Hardened beveled washers shall be used where the outer face of the bolted parts has a slope greater than 1:20 with respect to the bolt axis.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs at all permanently exposed connections, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.

- b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
- 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
- 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 Painting Sections.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. LH- and DLH-series long-span steel joists.
5. CJ-series composite steel joists.
6. Joist girders.
7. Joist accessories.

- B. Related Requirements:

1. Division 1 Section "Sustainable Project Design Requirements" for LEED standards and project requirements.
2. Division 3 Section "Cast-in-Place Concrete" for installing bearing plates in concrete.
3. Division 4 Section "Unit Masonry" for installing bearing plates in unit masonry.
4. Division 5 Section "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

- A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."
- B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS FOR REVIEW

- A. Product Data: For each type of joist, accessory, and product.

- B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

A. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit EQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Qualification Data: For manufacturer.

C. Welding certificates.

D. Manufacturer certificates.

E. Mill Certificates: For each type of bolt.

F. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete construction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
 - 1. Use ASD; data are given at service-load level.
 - 2. Design special joists to withstand design loads with live-load deflections no greater than the following:
 - a. Roof Joists: Vertical deflection of 1/240 of the span.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Domestic Steel: All steel shall be domestically manufactured, unless foreign sources are specifically accepted by the Owner.

2.2 K-SERIES STEEL JOISTS

- A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
 - 1. Joist Type: KCS-type and K-series steel joists as noted on the drawings.
- B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
- C. Provide holes in chord members for connecting and securing other construction to joists.
- D. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."
- E. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."
- F. Camber K-series joists according to SJI's "Specifications".
- G. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.
- H. Unless noted otherwise on plan, joist seat shall be designed for a minimum rollover capacity of 3.5 kips. When minimum rollover capacity cannot be provided, joist engineer shall coordinate an alternative solution with the Engineer of Record.

2.3 LONG-SPAN STEEL JOISTS (LH and DLH Series)

- A. Manufacture steel joists according to "Standard Specifications for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as follows:
 - 1. Joist Type: LH-series steel joists and DLH-series steel joists as indicated.
 - 2. End Arrangement: Underslung.
 - 3. Top-Chord Arrangement: Parallel.
- B. Provide holes in chord members for connecting and securing other construction to joists.
- C. Camber long-span steel joists according to SJI's "Specifications."
 - 1. Where long-span joists are adjacent to hard points, such as columns, CMU bearing walls, or concrete walls, camber and deflection shall be limited to one-half the deflection and one-half the camber of the interior roof joists unless noted otherwise on the drawings.
- D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.
- E. Unless noted otherwise on plan, joist seat shall be designed for a minimum rollover capacity of 8 kips. When minimum rollover capacity cannot be provided, joist engineer shall coordinate an alternative solution with the Engineer of Record.

2.4 PRIMERS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.
- C. Primer: Provide shop primer that complies with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.5 JOIST ACCESSORIES

- A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
- B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
- C. Bridging: Fabricate as indicated and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

- D. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint.
- E. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."
- F. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
- G. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.
 - 1. Finish: Plain, uncoated.
- H. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
 - 1. Finish: Plain.
- I. Welding Electrodes: Comply with AWS standards.
- J. Galvanizing Repair Paint: ASTM A 780.
- K. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.6 CLEANING AND SHOP PAINTING

- A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.
- B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.
- C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.
- D. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Do not install joists until supporting construction is in place and secured.
- B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJ's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.
 - 1. Before installation, splice joists delivered to Project site in more than one piece.
 - 2. Space, adjust, and align joists accurately in location before permanently fastening.
 - 3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
 - 4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.
- C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
- D. Bolt joists to supporting steel framework using carbon-steel bolts.
- E. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with Research Council on Structural Connection's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
- F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.
- B. Visually inspect field welds according to AWS D1.1/D1.1M.
 - 1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709.
 - c. Ultrasonic Testing: ASTM E 164.
 - d. Radiographic Testing: ASTM E 94.
- C. Visually inspect bolted connections.
- D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

- E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
 - 1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
 - 2. Apply a compatible primer of same type as primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:

1. Roof deck.
2. Acoustical roof deck.
3. Cellular roof deck.
4. Acoustical cellular roof deck.
5. Composite floor deck.
6. Electrified cellular floor deck.
7. Noncomposite form deck.
8. Noncomposite vented form deck.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 035216 "Lightweight Insulating Concrete" for lightweight insulating concrete fill over steel deck.
3. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
4. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
5. Section 099113 "Exterior Painting" for repair painting of primed deck and finish painting of deck.
6. Section 099123 "Interior Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.

- B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - 1. Power-actuated mechanical fasteners.
 - 2. Acoustical roof deck.
- D. Evaluation Reports: For steel deck.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
- C. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.
- D. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

- B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- D. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.2 ROOF DECK

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. [ASC Profiles, Inc.; a Blue Scope Steel company.](#)
 - 2. [Canam United States; Canam Group Inc.](#)
 - 3. [CMC Joist & Deck.](#)
 - 4. [Consolidated Systems, Inc.; Metal Dek Group.](#)
 - 5. [Cordeck.](#)
 - 6. [DACS, Inc.](#)
 - 7. [Epic Metals Corporation.](#)
 - 8. [Marlyn Steel Decks, Inc.](#)
 - 9. [New Millennium Building Systems, LLC.](#)
 - 10. [Nucor Corp.; Vulcraft Group.](#)
 - 11. [Roof Deck, Inc.](#)
 - 12. [Valley Joist; Subsidiary of EBSCO Industries, Inc.](#)
 - 13. [Verco Manufacturing Co.](#)
 - 14. [Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.](#)
- B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.
 - 2. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
 - 3. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
 - a. Color: Manufacturer's standard.

4. Aluminum-Zinc-Alloy-Coated Steel Sheet: ASTM A 792/A 792M, Structural Steel (SS), Grade 33 minimum, AZ50 aluminum-zinc-alloy coating.
5. Deck Profile: As indicated.
6. Cellular Deck Profile: As indicated, with bottom plate.
7. Profile Depth: As indicated.
8. Design Uncoated-Steel Thickness: As indicated.
9. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
10. Span Condition: As indicated.
11. Side Laps: Overlapped.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.
- J. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.
- L. Galvanizing Repair Paint: ASTM A 780.
- M. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Diameter: As indicated.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated.
 - 3. Weld Washers: Install weld washers at each weld location.

- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals as indicated, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Fasten with a minimum of 1-1/2-inch- long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.
- G. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.
- C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 2. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- C. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
- D. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 053100

SECTION 05 40 00 – COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Exterior non-axial load-bearing steel stud curtain wall, designed to resist positive and negative wind loads.
- B. Exterior soffit framing for metal soffits.
- C. Structural engineering services provided by cold-formed metal framing fabricator for exterior non-axial load-bearing steel stud curtain wall.
- D. Accessories.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 60 00 – Product Requirements: Product substitution procedures.
- C. Section 04 20 19 – Veneer Unit Masonry: Securing veneer anchors to exterior steel studs.
- D. Section 04 43 13 – Mortar Placed Stone Veneer: Securing veneer anchors to exterior steel studs.
- E. Section 06 10 53 – Miscellaneous Carpentry: Securing wood blocking to steel studs.
- F. Section 06 16 43 – Gypsum Sheathing: Securing gypsum sheathing to exterior steel studs.
- G. Section 07 21 16 – Blanket Insulation: Insulation within framing members of studs.
- H. Section 07 40 00 – Cladding Support System: Securing cladding support framing to exterior steel studs.
- I. Section 07 42 13 – Metal Wall and Soffit Panels: Securing metal wall and soffit panels to exterior steel studs.
- J. Section 09 21 16 – Gypsum Board Assemblies: Securing gypsum wall board to framing.
- K. Section 10 28 00 – Toilet, Bath and Laundry Accessories: Supporting toilet accessories off steel stud framing.

1.03 REFERENCES

- A. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-

Iron Alloy-Coated (Galvannealed) by Hot Dip Process.

- C. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - D. ASTM A1003 – Standard Specification for Steel Sheet, Carbon Metallic and Non-Metallic-Coated for Cold-Formed Framing Members.
 - E. ASTM C645 – Standard Specification for Non-Structural Steel Framing Members.
 - F. ASTM C754 – Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - G. ASTM C955 – Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
 - H. ASTM C1002 – Standard Specification for Steel Drill Screws for Application of Gypsum Panel Products on Metal Plaster Bases.
 - I. American Welding Society:
 - 1. AWS D1.1 – Structural Welding Code – Steel.
 - 2. AWS D1.3 – Structural Welding Code – Sheet Steel.
 - J. National Association of Architectural Metal Manufacturers:
 - 1. NAAMM ML/SFA 540 – Lightweight Steel Framing Systems Manual.
 - K. SSPC: The Society for Protective Coatings:
 - 1. SSPC Paint 20 – Zinc-Rich Primers (Type I – Inorganic and Type II – Organic).
 - L. Steel Stud Manufacturers Association:
 - 1. SSMA – Product Technical Information.
 - M. AISI – (American Iron and Steel Institute) “North American Specification for the Design of Cold-Formed Steel Structural Members,” Current Edition.
 - N. FS TT-P-645 – Primer, Paint, Zinc-2 Chromate, Alkyd Type.
- 1.04 PERFORMANCE REQUIREMENTS – EXTERIOR NON-AXIAL LOAD-BEARING STEEL STUD CURTAIN WALL
- A. AISI “Specifications”: Calculate structural characteristics of cold-formed metal framing according to AISI’s “North American Specification for the Design of Cold-Formed Steel Structural Members”.
 - B. Structural Performance: Engineer, fabricate and erect cold-formed metal framing to withstand design loads within limits and under conditions required.

1. Design framing systems to withstand design loads as indicated on the Structural Drawings and the following deflection criteria:
 - a. Deflection of L/600 of the wall height for masonry veneer.
 - b. Deflection of L/600 of the wall height for stone veneer.
 - c. Deflection of L/180 for metal wall panels and soffit panels.
 2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 120 degrees F.
 3. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
 - a. Vertical Deflection: Minimum 1 ½ inches, ¾ inches up and ¾ inches down.
- C. Design exterior non-axial load-bearing curtain wall framing to accommodate lateral deflection without regard to contribution of sheathing materials.
- D. Headers: Design according to AISI's "North American Standard for Cold-Formed Steel Framing" header design.
- E. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer, licensed in the state in which project is constructed, to prepare and sign and seal design calculations, Shop Drawings, and other structural data.
- 1.05 SUBMITTALS – EXTERIOR STEEL STUD NON-AXIAL LOAD-BEARING CURTAIN WALL FRAMING
- A. Section 01 33 00 – Submittal Procedures: Submittal requirements.
 - B. Submit structural calculations prepared by licensed engineer for review. Calculations shall include, but are not limited to:
 1. Description of design criteria.
 2. Engineering analysis depicting stress and deflection (stiffness) requirements for each framing application.
 3. Selection of framing components.
 4. Verification of attachments to structure and/or adjacent framing components.
 - C. Product data for each type of cold-formed metal framing, accessory and product specified.
 - D. Shop Drawings showing layout, spacings, sizes, thicknesses and types of cold-formed metal framing, fabrication, fastening and anchorage details including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units

of Work.

1. For cold-formed metal framing indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.
- E. Mill certificates signed by manufacturers of cold-formed metal framing certifying that their products comply with requirements, including uncoated steel thickness, yield strength, tensile strength, total elongation, and galvanized-coating thickness.

1.06 QUALITY ASSURANCE – EXTERIOR STEEL STUD CURTAIN WALL FRAMING

- A. Installer Qualifications: Engage an experienced Installer who has completed cold-formed metal framing similar in material, design and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Engineering Responsibilities: Preparation of Shop Drawings, design calculations and other structural data.
- C. Professional Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicted that have resulted in the installation of cold-formed metal framing similar to this Project in material, design and extent and that have a record of successful in-service performance.
- D. Calculate structural properties of framing members in accordance with AISI SG-973 Specification for Design of Cold-Formed Steel Structural Members.
 1. Furnish framing materials in accordance with SSMA – Product Technical Information.
- E. Pre-Installation Conference: Conduct conference at project site four weeks prior to the installation of framing to comply with requirements of Section 01 30 00 – Administrative Requirements: Pre-installation.
- F. Manufacturer: Company specializing in manufacturing products specified in this Section.
 1. Current member of Steel Stud Manufacturers Association.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Protect metal framing from corrosion, deformation and other damage during delivery, storage and handling.
- B. Store metal framing, protect with a waterproof covering and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers for Exterior Curtain Wall Studs: Subject to compliance with requirements, provide metal framing by one of the following:
 - 1. ClarkDietrich Building Systems.
 - 2. Craco Metal Manufacturing, LLC
 - 3. Marino/Ware – A Division of Ware Industries
- B. Basis-of-Design Product: The design for connecting devices for exterior curtainwall framing is based on The Steel Network, Inc.

Subject to compliance with requirements, provide named product or a comparable product by:
 - 1. ClarkDietrich Building Systems.
- C. Products shall comply with ASTM C955.

2.02 EXTERIOR CURTAIN WALL FRAMING

- A. Steel Sheet: ASTM A1003, structural grade, Type H, metallic coated, of grade and weight as follows:
 - 1. Grade: ST33H for 43 mil studs.
 - 2. Grade: ST50H for 54, 68 and 97 mil studs.
 - 3. Coating: G60.
- B. Steel sheet for vertical deflection clips, bridging and clips: ASTM A653, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 50, Class 1 or 2.
 - 2. Coating: G90.
- C. Wall Framing:
 - 1. Steel Studs: Manufacturer's standard C-shaped steel studs of web depths indicated, with lipped flanges and complying with the following:
 - a. Studs: C shaped structural studs, complying with SSMA.
 - b. Design Uncoated Steel Thickness: Stud gauge to be determined based on design criteria and stud span. But in no case shall the stud mils be less than 43.
 - c. Flange Width: Minimum 1-5/8 inch.
 - d. Web: Punched unless otherwise noted. Studs used as joists and headers shall be un-punched.
 - e. Stud Width: 2-1/2 inches, 3-5/8 inches, and 6 inches.
 - f. Stud Spacing: Maximum 16 inches o.c.
 - g. Metal soffit framing:
 - 1) Provide stud size as shown on drawings.

- 2) Space metal soffit framing in accordance with metal soffit manufacturer's requirements. Refer to Section 07 42 13 – Metal Wall and Soffit Panels.
 - 3 Secure framing to structural steel.
 2. Steel Track: Manufacturer's standard U-shaped steel track, unpunched of web depths to match width of studs with 1-1/4 inch straight flanges and as follows:
 - a. Track: Design uncoated steel thickness, match gauge of studs as a minimum, unless otherwise scheduled.
 3. Box Headers: Unless otherwise noted, all openings wider than stud spacing shall be framed with two-unpunched stud joists, with continuous metal tracks installed on the top and bottom sides of header and as follows:
 - a. Minimum Flange Width of Stud Joist: 1-5/8 inch.
 - b. Minimum Deflection: L/360.
 - c. Design Loads: Uniform load (lb/ft) shall be based on information shown on contract documents.
 - d. Depth and Mil Thickness: To be designed based on span and uniform load.
 4. Jamb Studs: Unless otherwise noted, as a minimum, install two studs and one track nested within stud at each side of all openings. Depth of stud and track along with flange width of the stud shall match wall studs. Flange width of track shall be minimum 1-1/4 inches. Support header at each end with header clips StiffClip HE by The Steel Network, Inc. or approved equal. Where clips are not used to support headers, provide additional stud and track to support box header. Studs and track shall extend the full height of the wall. The mil thickness of the studs and track along with the type and spacing of the fasteners shall be designed by the engineer based on:
 - a. Structural performance
 - b. Size of opening
 - c. Alternate Jamb Stud: In lieu of built-up multiple jamb studs provide JamStud by The Steel Network, Inc. Depth of stud to match wall studs.

The mil thickness of the stud shall be designed by the engineer based on:

 - 1) Structural performance
 - 2) Size of opening
 5. Bridging: 1-1/2 inch cold-rolled channels, 16- gauge, black finish or BridgeBar BB150 by The Steel Network Inc or approved equal.
- D. Framing Accessories:
 1. Fabricate steel-framing accessories of the same material and finish used for framing members, with a minimum yield strength of 33,000 psi for 43 mil material and 50,000 psi for 54, 68 and 97 mil thickness material.
 2. Bridging Clip: ASTM A653, 0.0346- inch design thickness, Grade 50, Class 1, 50

ksi yield strength, 65 ksi minimum tensile strength, G90 hot-dip galvanized coating BridgeClip as manufactured by The Steel Network, Inc. (TSN).

3. Vertical Deflection Clips: VertiClip as manufactured by The Steel Network, Inc. (TSN) ASTM A653, 68 mil thickness, 1-1/2 inches by 3-inch clips, Grade 50, Class 1, 50 ksi yield strength, 65 ksi minimum tensile strength, G90 hot dip galvanized coating. Provide clips with manufacturer's step bushings and load rated screw fasteners. Use only deflection connection products that comply with ICC Acceptance Criteria AC261 such as Report No. ESR-1903 (or equivalent). Field fabricated clips are not permitted. Provide the following clips where shown on Drawings:
 - a. Top of Wall (Head Condition): VertiClip SL: Length of clip to match width of studs.
 - 1) At roof slopes shown on Drawings, bend the horizontal leg as required to match roof slope. Vertical slots shall be cut plumb to allow for vertical movement.
 - 2) Framing system shall be installed to provide for a vertical deflection of 1-1/2 inches (3/4 inch up and 3/4- inch downstep bushings).
 - 3) Provide clips with two slots, two screws and two step bushings. Based on loads, provide clips with three slots, three screws and three step bushings.
4. Header Clips: ASTM A653, Grade 50, Class 1, 50 ksi minimum yield strength, 65 ksi minimum yield tensile strength, G-90 hot-dipped galvanized coating, StiffClip HE as manufactured by The Steel Network, Inc. or approved equal. The gauge of the clip and number of fasteners shall be based on the design loads.
5. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - a. Supplementary framing.
 - b. Bracing, bridging and solid blocking.
 - c. Web stiffeners.
 - d. Stud kickers and girts.
 - e. Reinforcement plates.
6. Flat Steel Plate: Steel sheet complying with ASTM A653 or ASTM A568 with minimum base metal thickness as follows:
 - a. Thickness:
 - 1) 54 mils (16 gauge) ,33 ksi steel.
 - b. Width: 6 inches.
 - c. Length: 10 feet.

2.03 ANCHORS, CLIPS AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.

- B. Powder-Actuated Anchors: Federal Specification FF-P-395b. Manufactured from AISI 1062 or 1065 steel, austempered to a minimum core hardness of 50 to 54 HRC and zinc plated in accordance with ASTM B633. Provide fasteners listed or approved by one or more of the following and of type, diameter and length as required by structural design calculations:
 - 1. Underwriters Laboratory.
 - 2. Factory Mutual.
 - 3. International Code Council (ICC).
- C. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Provide screw type and size as required by structural design calculations for the specific condition and thickness of materials being joined.
 - 1. Head Type: Low profile head beneath sheathing, manufacturer's standard elsewhere.

2.04 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

2.05 FABRICATION

- A. Fabricate metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
 - 1. Fabricate framing assemblies in jig templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten metal framing members by screw fastening as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to metal framing manufacturer's instructions with screw penetrating jointed members by not less than 3 exposed screw threads.
 - 4. Fasten other materials to metal framing by bolting, or screw fastening according to manufacturer's recommendations.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.
- C. Fabrication Tolerances: Fabricate assemblies to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify that building framing components are ready to receive work.
- B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION – GENERAL

- A. Install metal framing and accessories plumb, square, true to line and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
 1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten metal framing members by screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
- D. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- E. Provide temporary bracing and leave in place until framing is permanently stabilized.
- F. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.
- G. At all locations where multiple studs and tracks occur, fasten studs and tracks together at maximum 24 inches on center.

3.03 EXTERIOR NON-AXIAL LOAD-BEARING CURTAIN WALL INSTALLATION

- A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing – General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- B. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated, and at spacings as determined by structural design calculations for power driven fasteners.
- C. Install jack studs and braces below window sills, above window headers and elsewhere to provide structural support and bracing.
- D. Provide minimum 3 studs at corners.

- E. Install horizontal bridging in stud system spaced at mid-height for walls up to 10'-0" in height. For walls over 10'-0", install bridging at 48 inches on center.
 - 1. Bridging: Continuous 16-gauge cold-rolled steel channel, with bridging clip secured to each stud web by inseting tabs through web slots and fastened to stud with 2-#10 diameter screws provided by the clip manufacturer. Secure cold-rolled channel to clip with 1-#10 screw provided by clip manufacturer. In lieu of cold-rolled channel provide BridgeBar 150 as manufactured by The Steel Network or approved equal. Secure BridgeBar to BridgeClip.
- F. Install headers over wall openings wider than the stud spacing. Fabricate headers of compound shapes indicated, complete with clip-angle connectors, web stiffeners or gusset plates.
 - 1. Frame wall openings with not less than a double stud and track nested within stud at each jamb of frame as required by manufacturer.
 - 2. Where header clips are not used, install jack studs or cripples below window sills and above window heads.
 - 3. Install intermediate studs above and below openings to align with wall stud spacing.
- G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable curtain wall framing system.
- H. At ends of studs provide a minimum of 10 inches of unpunched steel. Where field cuts reduce this minimum 10-inch unpunched steel, install web stiffening in accordance with manufacturers' requirements.
- I. Isolate steel framing from building structure at locations indicated to prevent transfer of vertical loads while providing lateral support.
 - 1. Install deflection clips as shown on Drawings.
 - a. Secure clips to primary structure.
 - b. Position slotted holes of clip vertically. Secure clips to each stud using fasteners provided by the manufacturer through the center of each step, bushing. Verify step bushing is fully seated inside each slot. Do not remove tape until screws have been installed through each brushing.

3.05 TOLERANCES

- A. Maximum Variation from Plumb, Level and True Position: 1/8 inch in 10 feet.

END OF SECTION

SECTION 05 50 00 – METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes shop-fabricated metal items.
 - 1. Bollards.
 - 2. Ladders
 - a. Aluminum.
- B. Related Sections:
 - 1. Section 05 12 00 – Structural Steel Framing: Steel lintels.
 - 2. Section 07 72 33-Roof Hatches: Coordinating roof hatch with roof access ladders.
 - 3. Section 09 90 00 – Painting and Coating: Field-applied paint finish.

1.02 REFERENCES

- A. Aluminum Association:
 - 1. AA DAF-45 – Designation System for Aluminum Finishes.
- B. American National Standards Institute:
 - 1. ANSI A14.3 – American National Standard (ASC) for Ladders – Fixed – Safety Requirements.
- C. ASTM International:
 - 1. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 5. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts.
 - 6. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

- 7. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 8. ASTM F436 – Standard Specification for Hardened Steel Washers.
 - D. OSHA, Occupational Safety and Health Administration.
 - 1. 29 CFR 1910.23 Ladders.
- 1.03 SUBMITTALS
- A. Section 01 33 00 – Submittal Procedures: Submittal requirements.
 - B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Include elevations, and details where applicable.
- 1.04 QUALITY ASSURANCE
- A. All ladders shall comply with ANSI A14.3 and OSHA 29 CFR 1910.23 Fixed Ladders and local building codes.
- 1.05 DELIVERY, STORAGE AND HANDLING
- A. Section 01 60 00 – Product Requirements: Product Storage and Handling Requirements.
 - B. Accept metal fabrications on site in labeled shipments. Inspect for damage.
 - C. Protect metal fabrications from damage by exposure to weather.
- 1.06 FIELD MEASUREMENTS
- A. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS – STEEL

- A. Steel Pipe: ASTM A53/A53M, Grade B, Schedule 40.
- B. Bolts: ASTM A325; Type 1
 - 1. Finish: Unfinished unless otherwise noted. Provide hot-dipped galvanized finish as required by ladder manufacturer.
- C. Nuts: ASTM A563 heavy hex type.
 - 1. Finish: Unfinished unless otherwise noted. Provide hot-dipped galvanized as required by ladder manufacturer.
- D. Washers: ASTM F436; Type 1.
 - 1. Finish: Unfinished unless otherwise noted. Provide hot-dipped galvanized as

required by ladder manufacturer.

2.02 MATERIALS – ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6063, Temper T5.

2.03 BOLLARDS

- A. Bollards: ASTM A53/A53M, Grade B, Schedule 40 steel pipe, concrete filled, crowned cap, diameter and length as indicated on Drawings; ASTM A123, hot dipped galvanized.
- B. Concrete Fill: 3,000 psi as specified in Section 03 30 00.

2.04 ALUMINUM HATCH ACCESS LADDERS

- A. Manufacturer – Basis of Design

- 1. Royalite Manufacturing, Inc.
- 2. Ladders shall comply with ANSI A14.3 and OSHA Standards.

- B. Approved manufacturers offering equal products:

- 1. O’Keeffe’s Inc.
- 2. Precision Ladders.

- C. Hatch Access Ladder

- 1. Royalite “Sure-Step” Hatch Ladder, Model (HL) with “Lift Up Rail Extensions.”
- 2. All ladders shall be submitted and approved prior to fabrication showing full dimensions, wall and floor attachments, materials, construction and finish. All ladders must comply with all safety orders pertinent to the installation. Materials shall be electrolysis and maintenance free aluminum or #302 stainless steel. Side rails shall lift up and lock 42 inches above the top step of the ladder for safe egress and ingress and retract into the ladder frame when the roof hatch is in the closed position.
- 3. Steps shall be 2-inch by 1-inch in section by 24 inches long, extruded from 6063-T5 aluminum, serrated on the top surface, smooth rounded on the sides and bottom. Steps shall carry a 1200 lb. load without failing. Spacing shall be 12 inches vertically.
- 4. Heavy-duty side rails shall be extruded from 6063-T5 aluminum, no less than .125-inch wall thickness by 4 inches wide mounted so that centerline of tread is minimum of 7 inches from face of wall. Rails shall be rounded on the corners and protected on the exterior to prevent tampering or vandalism of the step fasteners. Side rails shall be constructed using 302 stainless steel self-locking fasteners, full penetration inert gas heliarc welds, ground smooth and burr free.
 - a. Wall brackets: Bent aluminum plate, 2 inches wide by 3/16 inch thick.
 - b. Base brackets: Aluminum angle floor bracket, 2 inches by 2 inches by 2 inches by 1/8 inch.

5. Lift-up side rails shall be made of 6063-T5 extruded aluminum, extended and lock 42 inches about the top step, then retract into the heavy-duty rails by releasing the latch mechanism located near the top of the side rails.
6. Finish shall be Mill finish.
7. Anchor Bolts: Hot-dipped galvanized or stainless steel bolts. Diameter as specified by the ladder manufacturer. Fastener length as required to provide adequate anchorage to substrate provided by project contractor as determined by the project engineer.

2.05 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.06 FACTORY-APPLIED FINISHES – STEEL

- A. Galvanizing: ASTM A123/A123M; minimum 2.0 oz/sq. ft. coating thickness; galvanize after fabrication.
- B. Galvanizing for Fasteners, Connectors and Anchors:
 1. Hot-Dipped Galvanizing: ASTM A153/A153M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify field conditions are acceptable and are ready to receive Work.

3.02 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Obtain approval of Architect/Engineer prior to site cutting or making adjustments not scheduled.
- C. Install manufactured ladders in accordance with manufacturer's instructions.
 1. Anchor securely using fasteners specified by manufacturer or others of equivalent or greater strength and corrosion resistance.

END OF SECTION

SECTION 05 52 00 – HANDRAILS AND RAILINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes steel pipe railings, guardrails, balusters, fittings, handrails and wire mesh.
 - 1. Provide mechanical fasteners at connections and structural adhesive for splices.
- B. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete: Execution requirements for placement of anchors specified in this section in concrete.
 - 2. Section 09 90 00 – Painting and Coating: Paint finish work.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM E894 (Reapproved 2004) – Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 - 4. ASTM E935 – Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 - 5. ASTM E985 – Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
- B. National Ornamental & Miscellaneous Metals Association:
 - 1. NOMMA Guideline 1 – Joint Finishes.
- C. SSPC: The Society for Protective Coatings:
 - 1. SSPC – Steel Structures Painting Manual.
 - 2. SSPC Paint 15 – Steel Joist Shop Primer/Metal Building Primer.
 - 3. SSPC Paint 20 – Zinc-Rich Coating, Type I – Inorganic and Type II – Organic.

1.03 DESIGN REQUIREMENTS

- A. Structural Performance: Engineer, fabricate and install handrails, guardrails and railing systems to withstand, when tested per ASTM E985, for structural performance based on

the following:

1. Testing performed according to ASTM E894 and E935.
- B. Structural Performance: Engineer, fabricate and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each of the respective components of each metal fabrication.
 1. Guards: Capable of withstanding the following loads applied as indicated.
 - a. Concentrated Load: Single concentrated load of 200 lbs applied in any direction at any point along the top, and have attachment devices and supporting structure to transfer this loading to appropriate structural elements of the building.
 - b. Uniform load of 50 lbs per linear foot applied in any direction at the top and to transfer this load through the supports to the structure.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 2. Handrails: Capable of withstanding the following loads applied as indicated.
 - a. Concentrated Load: Single concentrated load of 200 lbs applied in any direction at any point along the top, and have attachment devices and supporting structure to transfer this loading to appropriate structural elements of the building.
 - b. Uniform load of 50 lbs per linear foot applied in any direction at the top and to transfer this load through the support to the structure.
 - c. Concentrated and uniform loads above need not be assumed to act concurrently.
 3. Components: Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontal applied normal load of 50 pounds on an area equal to one square foot, including openings and space between rails.
 - a. Reactions due to this loading are not required to be superimposed with those of either B1 or B2 above.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners and accessories.
 1. Shop Drawings shall be signed and sealed by a licensed engineer in the State of Texas.

1.05 QUALITY ASSURANCE

- A. Finish joints in accordance with NOMMA Guideline 1.

1.06 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 STEEL RAILING SYSTEM COMPONENTS

- A. Pipe: ASTM A53, Grade B, Standard Weight (Schedule 40)
 - 1. Size: 1 1/4 inches iron pipe size, outside diameter 1.66 inches, unless otherwise noted on the Drawings.
- B. Fittings: Wall brackets, cast steel.
 - 1. Wall Brackets: Universal steel wall brackets #1929-3 with 4579 filler 5/8" deep for use at metal stud / metal wall furring and gypsum wall board walls as manufactured by R & B Wagner Inc. or equal.
 - a. At masonry and concrete walls provide 1929.PL Universal steel wall brackets as manufactured by R & B Wagner Inc. or equal.
- C. Exposed Fasteners: Flush countersunk screws or bolts; consistent with design of railing.
- D. Splice Connectors: Steel concealed spigots.
- E. Galvanizing: All exterior handrails, guardrails and railings shall be hot-dip galvanized per ASTM A123/A123M; galvanize after fabrication.
- F. Shop Primer: SSPC Paint 15, Type 1 Red Oxide.
- G. Non-Shrink, Non-Metallic Grouts:
 - 1. Euco N-S Grout; Euclid Chemical Co.
 - 2. Crystex; L & M Construction Chemicals, Inc.
 - 3. 588 Grout; W.R. Meadows, Inc.
 - 4. SonogROUT 10K; Sonneborn Building Products – ChemRex, Inc.
- H. Erosion-Resistant Anchoring Cement:
 - 1. Commercial Anchor Cement; W.R. Bonsal Co.
 - 2. Super Por-Rok;CGM Incorporated.
 - 3. Thorogrip; Thoro Systems Products.
- I. Touch-Up Primer: Match shop primer.
- J. Rust Preventative/Anti-Corrosive Touch-Up Primer/Coating for Galvanized Surfaces: SSPC Paint 20, Type II Organic zinc rich.

1. ZRC Zero VOC Water-Based Galvanizing Compound as manufactured by ZRC Worldwide.
 2. VOC: 0 g/L
- K. Mounting brackets for removable handrails/guardrails:
1. Manufacturer: Safety Rail Company.
 2. Products:
 - a. Face Mount End, single post 400563.
 - b. Face Mount, two posts 400564.

2.02 FABRICATION

- A. Fit and shop assemble components in largest practical sizes for delivery to site.
- B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate site assembly and installation.
- C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- E. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.
- F. Interior Components: Continuously seal joined pieces by continuous welds.
- G. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish 1.
- H. Accurately form components to suit stairs, ramps and landings, to each other and to building structure.
- I. Accommodate for expansion and contraction of members and building movement without damage to connections or members.
- J. Provide inserts and other anchorage devices to connect handrails and railing systems to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.
- K. For railing posts set in concrete, provide preset sleeves of steel, not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, and steel plate forming bottom closure.
 1. In lieu of setting railing posts in preset sleeves, contractor may core drill concrete, minimum 6 inches deep with inside dimensions of not less than 1/2 inch greater than outside dimensions of post.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and Project Conditions.
- B. Verify field conditions are acceptable and are ready to receive work.
- C. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.02 PREPARATION

- A. Supply items required to be cast into concrete with setting templates, to appropriate sections.

3.03 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Anchor railings to structure with anchors, plates or angles.
- C. Field weld anchors as indicated on Drawings. Touch up welds with primer. Grind welds smooth.
- D. Conceal bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Assemble with spigots and sleeves to accommodate tight joints and secure installation.
- F. Unless otherwise noted on the Drawings, install wall brackets at maximum 5'-0" on center.
- G. Anchor posts in concrete by forming or core-drilling holes not less than 6 inches deep and 1/2 inch greater than outside diameter of post. Set the centerline of the posts a minimum of 4 inches away from the vertical edge of concrete walks, ramps or steps. Clean holes of all loose material, insert posts, and fill annular space between post and concrete with the following anchoring material, mixed and placed to comply with anchoring material manufacturer's directions.
 - 1. Non-shrink, non-metallic grout or anchoring cement.
- H. Removable guardrails/handrails:
 - 1. For single posts provide face mount end brackets weld to steel.
 - 2. For two posts provide face mount brackets, weld to steel.

3.04 ERECTION TOLERANCES

- A. Section 01 40 00 – Quality Requirements: Tolerances.
- B. Maximum Offset from Alignment: 1/4 inch.

- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 53 – MISCELLANEOUS CARPENTRY

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Roof curbs, cants and perimeter and miscellaneous nailers and exterior plywood sheathing.
- B. Blocking in wall and roof openings.
- C. Concealed wood blocking for support of wall-hung equipment, fixtures, accessories and where shown on Drawings.
- D. Telephone, electrical and technology panel backboards.
- E. Wood treatment.
- F. Separation sheet.
- G. Rigid wall backing plates.

1.02 RELATED SECTIONS

- A. Section 04 20 19 – Veneer Unit Masonry: Fasteners used to secure through-wall flashing to treated wood nailers.
- B. Section 04 43 13 – Mortar-Placed Stone Veneer: Fasteners used to secure through-wall flashing to treated wood nailers.
- C. Section 04 72 00 – Cast Stone Masonry: Fasteners used to secure through-wall flashing to treated wood nailers.
- D. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Covering preservative-treated materials with transition membranes.
- E. Section 07 54 23 – Thermoplastic Polyolefin Roofing: Covering preservative-treated materials with roof membrane and size and spacing of fasteners per FM requirements.
- F. Section 07 62 00 – Sheet Metal Flashings and Trim: Fasteners used to secure sheet metal flashing to treated wood nailers, blocking, curbs and cants.
- G. Section 07 72 33 – Roof Hatches.

1.03 REFERENCES

- A. APA American Plywood Association.
- B. SPIB – Southern Pine Inspection Bureau.
 - 1. SPIB – Standard Grading Rules for Southern Pine Lumber.
- C. American Society for Testing and Materials (ASTM):

1. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 2. ASTM A653 – Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Coated (Galvannealed) by Hot Dip Process.
 3. ASTM D5516: Standard test method for evaluating the flexural properties of fire-retardant-treated softwood plywood exposed to elevated temperatures.
 4. ASTM D5664: Standard test method for evaluating the effects of fire-retardant treatments and elevated temperatures on strength properties of fire-retardant-treated lumber.
 5. ASTM E84: Standard test method for surface burning characteristics of building materials.
 - a. Maximum flame spread for fire-retardant-treated materials: 25/450 flame spread/smoke developed index.
 6. ASTM F1667 – Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- D. American Wood-Preservers' Association (AWPA)
1. AWPA Standard P5 – Standard Waterborne Preservatives.
 2. AWPA Standard P17 – Fire Retardant Formulations.
 3. Standard M4, Care of Preservative Treated Wood Products.
 4. AWPA Standard U1 – Use Category System.
 5. AWPA E12 – Standard Method of Determining Corrosion of Metal in Contact with Treated Wood.
- E. Military Specification (Mil. Spec.):
1. Mil. Spec. L-19140E, Lumber and Plywood, Fire Retardant Treated.
- F. National Fire Protection Association (NFPA):
1. NFPA 255 Standard Test Method for Surface Burning Characteristics of Building Materials.
- G. Underwriters Laboratories, Inc. (UL):
1. UL 723 Test for Surface Burning Characteristics of Building Materials.
 2. UL Building Materials Directory.
- H. U.S. Department of Commerce National Institute of Standards and Technology:
1. DOC PS1 – Construction and Industrial Plywood.

2. DOC PS2 – Performance Standard for Wood-Based Structural-Use Panels.
 3. DOC PS 20 – American Softwood Lumber Standard.
- I. Wood Blocking at Grab Bars, Shower Seats and Bench Seats:
1. Grab bars, shower seats and dressing room bench seats shall be designed to resist a single concentrated load of 250 pounds applied in any direction at any point.

1.04 QUALITY ASSURANCE

- A. Lumber Grading Agency: Certified by DOC PS 20.
- B. Plywood Grading Agency: Certified by APA/EWA.
- C. Pressure-Treated Wood Treatment Facility: Provide treated materials that have been produced under an ALSC recognized quality assurance program.
- D. Wood Treatment Plant Qualifications: Wood treatment plant experienced in performing work of this section which has specialized in the treatment of wood similar to that required for this project and a plant licensed by treatment manufacturer.
- E. Apply label from agency approved by authority having jurisdiction to identify each fire retardant treated material.
- F. Treated Material: All preservative-treated wood members shall bear an end tag or permanent ink stamp indicating the following:
 1. Identification of the inspection agency.
 2. Identification of the standard to which the material was treated.
 3. Identification of the treating facility.
 4. Identification of the preservative and retention.
 5. Identification of the end use for which the product is suitable.
- G. Test Report for Fire Retardant Treatment: Certified test report showing compliance with specified performance characteristics and physical properties. Include in test report certification that fire retardant solution does not contain ammonium phosphate.
 1. Evaluation Report: National Evaluation Report ESR-1626 or ICBO ER-5755 indicating flame spread, strength, corrosion and hygroscopic properties.

1.05 SUBMITTALS

- A. Submit product data under provisions of Section 01 30 00.
- B. Wood treatment data as follows, including chemical treatment manufacturer's instruction for handling, storing, installing and finishing treated materials:

1. For fire-retardant-treated wood products, include certification by treating plant that treated materials comply with specified standard and other requirements as well as data relative to bending strength, stiffness and fastener-holding capacities of treated material.
 2. For preservative-treated materials, provide manufacturer's test results based on AWPA E12-94 Standard Test Method of Determining Corrosion of Metal In Contact With Treated Wood.
- C. Warranty of chemical treatment manufacturer for each type of treatment.
1. Fire Retardant Treatment: Provide manufacturer's 40-year preservative warranty covering fire-retardant-treated materials commencing on date of substantial completion.
- D. Fasteners: Provide manufacturer's recommendations for types of fasteners to be used with treated materials.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Keep materials under cover and dry. Protect from weather and contact with damp or wet surface. Stack lumber, plywood and other panels. Provide for air circulation within and around stacks and temporary coverings. Store materials off the ground
- B. Allow materials exposed to incidental moisture to dry thoroughly prior to covering with vapor- or moisture-retarding finish materials.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Lumber in accordance with DOC PS 20 and as follows:
 1. Softwood Lumber: Southern Pine species, #2 grade.
 - a. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified.
 - b. Provide dressed lumber S4S, surfaced four sides.
 - c. Moisture content: Kiln dried to 19 percent maximum moisture content at time of dressing for lumber not to receive wood preservative or fire retardant treatment.
- B. Plywood in accordance with DOC PS 1 and as follows:
 1. Exterior
 - a. Not Exposed: APA rated all veneer plywood sheathing, exterior, Group 1 minimum 5 plies, of thickness shown on Drawings.
 - b. Moisture content of panels at time of shipment shall not exceed 18 percent.
 2. Interior

- a. Not Exposed: APA rated all veneer plywood sheathing, exposure 1, Group 1, minimum 5 plies, of thickness indicated on Drawings.
 - b. Moisture content of panels at time of shipment shall not exceed 18 percent.
- C. Plywood Backing Panels: For mounting electrical, telephone equipment, or technology equipment, APA rated all veneer plywood sheathing, Grade C-D plugged, exposure 1, minimum 5 plies, minimum 3/4 inch thick unless otherwise indicated.
1. Products shall contain no added formaldehyde resins.
- D. Separation Sheet: Provide only membranes with the ability to withstand temperatures over 240 degrees F.
1. Grace Construction Products/Grace Ice & Water Shield HT.
 2. Carlisle Coatings and Waterproofing/WIP 300 HT.
 3. Mid-States Asphalt Quik-Stick HT Pro.
- E. Wood blocking at grab bars, shower seats, bench seats, floor-mounted cabinets and wall-hung cabinets:
1. Provide a rigid wall backing system; Backit as manufactured by The Steel Network.
 2. Substitutions Permitted: Provide test reports verifying system will resist the following loads in accordance with the International Building Code:
 - a. Resist a minimum of 200 lbs. of concentrated load or 50 lbs. per linear foot in any direction.
 - b. Resist a concentrated load of 250 lbs.
 3. Material: ASTM A653, Grade 33, 33 ksi minimum yield strength, 45 ksi minimum tensile strength, G-60 hot-dipped galvanized coating. Material thickness 20 gauge, 33 mil.

2.02 ANCHORAGE AND FASTENING MATERIALS

- A. Select proper type, size, material and finish for each application. Comply with the following:
1. Nails and Staples: ASTM F 1667.
 2. Wood Screws: FS FF-S-111D(1).
 3. Bolts and Studs: FS FF-B-575D.
 4. Nuts: FS FF-N-836E.
 5. Washers: FS FF-W-92B(1).
 6. Lag Screws or Lag Bolts: ANSI-B18.2.1.
 7. Masonry Anchoring Devices: For expansion shields, nails and drive screws comply

with A-A-1922A.

8. Toggle Bolts.
 9. Bar or Strap Anchors: ASTM A575 carbon steel bars.
- B. Fasteners and Anchors: All fasteners and anchors used in contact with pressure-treated wood and in high humidity locations (lumber and plywood) shall be labeled as appropriate for use with the specified wood treatments and shall be:
1. Screws, nails and small bolts: Stainless steel Type 304 or 316, size and type to suit condition.
 2. 1/4-inch diameter and larger bolts: Hot-dipped galvanized per ASTM A153.
 3. Fasteners with proprietary anti-corrosion coatings may be submitted for use with treated wood, size and type to suit location. When submitted, the fastener manufacturer shall furnish specific information regarding the performance of their products in the specified treated wood and any precautions or special instructions that may be applicable.
 4. Anchors: Expansion shield and lag bolt type for anchorage to concrete and hollow masonry. Bolts or ballistic fasteners for anchorages to steel and concrete.
 5. At all non-treated and fire-retardant-treated locations, provide hot-dipped galvanized per ASTM A153 unless noted otherwise in Article 3.02, size and type to suit location.

2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with AWWPA Standard U1. Identify fire-retardant-treated wood with appropriate classification marking of UL; U.S. Testing; Timber Products Inspection, Inc.; or another testing and inspecting agency acceptable to authorities having jurisdiction.
1. Manufacturer: Arch Wood Protection, Inc.
 2. Treatment Type: Interior Type A.
 3. Product: Dricon FRT.
- B. Inspect each piece of treated lumber or plywood after drying and discard damaged or defective pieces.
- C. Fire retardant chemicals shall be free of halogens, sulfates and ammonium phosphate, and must comply with FR-1 of AWWPA standard P17.
- D. All fire retardant treated wood shall be kiln dried after treatment to a moisture content of 19 percent for lumber and 15 percent for plywood
- E. The fire protection chemical shall provide protection against termites and fungal decay and must be registered for use as a wood preservative by the U.S. Environmental Protection Agency.

- F. Testing on the fire performance, strength and corrosive properties of the fire retardant treated wood shall be recognized by issuance of a National Evaluation Services Report.
- G. Carbon steel, galvanized steel, aluminum, copper and red brass in contact with the fire-retardant-treated wood must exhibit corrosion rates less than one mil per year when tested in accordance with Federal Specification MIL-L-19140, paragraph 4.6.5.2.
- H. All fire-retardant wood must have a listed flame spread of less than 25 and show no evidence of significant progressive combustion when the test is continued for an additional 20-minute period. Additionally, the flame front shall not progress more than 10 1/2 feet beyond the centerline of the burners at any time during the test. Test in accordance with ASTM E84 or UL 723.

2.04 PRESERVATIVE-TREATED MATERIALS

- A. Water-Borne Preservative: Ca-C, copper azole Type C.
- B. Lumber shall be Southern Pine treated with copper azole, Type C, in accordance with AWWA Standard U1, Commodity Specification A, to the requirements of Use Category 3B.
- C. Plywood shall be treated with copper azole, Type C, in accordance with AWWA Standard U1, Commodity Specification F, to the requirements of Use Category 3B.
- D. Moisture Content: Drying after treatment as follows:
 - 1. Lumber: 19 percent maximum.
 - 2. Plywood: 18 percent maximum.

PART 3 EXECUTION

3.01 FRAMING

- A. Set members level and plumb, in correct position.
- B. Place horizontal members crown side up.
- C. DO NOT rip or mill fire retardant lumber unless the material carries a ULI approved milling after treatment label. If lumber does not carry a ULI approved label, only end cuts, drilling holes and joining cuts are permitted. All cuts on plywood are considered end cuts. Where lumber is detailed with a bevel edge, cut lumber prior to treatment or provide treated red oak or yellow poplar.
- D. Securely attach carpentry work. Use fasteners of appropriate type and length. Coordinate with applicable specification section for size and spacing of fasteners.
- E. Separate all surfaces of preservative-treated wood in contact with the following materials using the sheet materials specified in Article 2.01. The separations sheet shall be installed continuously. Separation sheet materials which are not self-adhesive shall be fastened to the treated wood/plywood using stainless steel nails.
 - 1. Structural and non-structural steel (galvanized and ferrous).

2. Metal flashings and metal trim.

3.02 NAILERS

- A. Install nailers at all open eaves and edges, where wood cants are installed, where wood curbs are installed and where shown on Drawings. Nailers shall be treated wood blocks the same thickness as the roof insulation and shall be a minimum of 5-1/2 inches wide, unless otherwise noted on the Drawings.
- B. Secure wood nailers to roof structure in accordance with the current edition of ANSI/SPRI ES-1.
 1. Bottom nailers: Where the nailers are secured to the metal roof deck, install the bottom nailer to the metal deck with two rows of No. 10 steel screws spaced at 12 inches on center. Place a 5/8 inch outside diameter steel washer under the head of each screw. At corner regions, space screws at 6 inches on center. Each wood nailer shall have at least two fasteners. A fastener shall be located approximately 4 inches but not less than 3 inches from each end.
 - a. Screws and washers installed in preservative-treated wood shall be:
 - 1) Stainless steel type 304 or 316;
 - 2) Proprietary anti-corrosion coatings which have been recommended by manufacturer for use with preservative-treated materials.
 2. Bottom nailers: Where the nailers are secured to steel angles/plates, install the bottom nailer to the steel angle/plate with hot-dipped galvanized steel bolts or hot – dipped galvanized threaded studs welded to angle/plate, hot-dip galvanize per ASTM A153. Bolts/studs shall be 1/2 inch diameter with nuts and washers spaced at 48 inches on center. At corner regions, place bolts/studs at 24 inches on center. Each bolt shall have two washers, one under each bolt head and one under each nut. Each stud shall have one washer under each nut. For wood nailers wider than 5-1/2 inches, bolts/studs shall be staggered. Each wood nailer shall have at least two bolts/studs. A bolt/stud shall be located 4 inches from each end of wood nailer.
 3. Top nailers: Secure top nailers to bottom nailer with annular ring shank nails. Nails shall be long enough to penetrate 1-1/4 inches into the bottom nailer and each additional nailer layer. Provide two rows staggered spaced at 12 inches on center. maximum. Spacing shall not exceed 6 inches, at corner regions. Withdrawal resistance should be 200 lb per nail.
 - a. Nails installed in preservative-treated wood shall be:
 - 1) Stainless steel type 304 or 316;
 - 2) Proprietary anti-corrosion coatings which have been recommended by manufacturer for use with preservative-treated materials.
 - C. Secure wood nailers around the perimeter of openings in the exterior wall of metal stud construction with the following fasteners:
 1. At window openings secure the 2 x wood nailers plus two layers of 5/8 inch plywood, unless otherwise noted on the drawings (preservative treated/fire-retardant treated) through the 1/2 inch sheathing to the metal stud framing using Rodenhouse Inc., #10 Grip Deck Ceramic Coated self-drilling screws. Pre drill wood.

- a. At 3 ½ inch wide material provide two fasteners centered as shown, spaced at maximum 16 inches on center. Ensure fasteners engage metal stud framing minimum 4 pitches of thread.
- b. At 5 ½ inch wide material provide two vertical rows of fasteners, spaced as shown at maximum 16 inches on center. Ensure fasteners engage metal stud framing minimum 4 pitches of thread.

3.03 SCHEDULING

- A. Roof cant, roof nailers, roof blocking, roof curbing:
 1. Southern pine species for lumber, preservative treated.
 2. Group 1, exterior grade for veneer core plywood, preservative treated.
- B. Blocking/nailers in exterior cavity wall openings:
 1. Southern pine species for lumber, preservative treated.
 2. Group 1, exterior grade for veneer core plywood, preservative treated.
- C. Blocking/nailers in exterior wall openings:
 1. Southern pine species for lumber, preservative treated.
 2. Group 1, exterior grade for veneer core plywood, preservative treated.
- D. Wood blocking at window heads:
 1. Southern pine species for lumber, fire-retardant treated.
 2. Group 1, exterior grade for veneer core plywood, fire-retardant treated.
- E. Concealed wood blocking in interior metal stud partitions for supporting washroom accessories, door stops, toilet partitions, wall-hung equipment, markerboards, tackboards, projection screens, acoustic wall panels, steel support brackets, etc:
 1. Southern pine species for lumber, untreated. Wood blocking or nailers on metal stud framing shall be bolted to framing.
- F. Concealed wood blocking in interior metal stud partitions for supporting grab bars, shower seats, bench seats, floor-mounted cabinets and wall-hung cabinets.
 1. 2 by 6 Southern pine, untreated, installed with Backit rigid wall backing. Provide an approved hot-dipped galvanized screw fastener in each guide hole in the rigid wall backing plate.
- G. Telephone, electrical and technology panel boards:
 1. Fire-retardant-treated veneer core plywood panel. Paint panel black.

END OF SECTION

SECTION 06 16 43 – GYPSUM SHEATHING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Glass-Faced Wall Sheathing.
- B. Roof Board.

1.02 RELATED SECTIONS

- A. Section 01 60 00 – Product Requirements: Substitutions.
- B. Section 05 40 00 – Cold-Formed Metal Framing.
- C. Section 06 10 53 – Miscellaneous Carpentry.
- D. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Sealing joints in glass-faced sheathing.
- E. Section 07 54 23 – Thermoplastic Polyolefin Roofing: Securing roof membrane to roof board.

1.03 REFERENCES

- A. ASTM C473 – Standard Test Methods for Physical Testing of Gypsum Panel Products.
- B. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of Heat Flow Meter Apparatus.
- C. ASTM C954 – Standard Specification for Drill Screws for the Application of Gypsum Board or Metal Plaster Bases to Steel Studs from 0.033 in. to 0.112 in. in thickness.
- D. ASTM C1002 – Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- E. ASTM C1177 – Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- F. ASTM C1280 – Standard Specification for Application of Gypsum Sheathing.
- G. ASTM D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environment Chamber.
- H. ASTM E72 – Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
- I. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- J. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.

- K. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
- L. ASTM E136 – Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit technical data on sheathing and roof board.
- C. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
 - 1. Roof board manufacturer shall verify in writing, that the material is compatible with roof membrane system.

1.05 QUALITY ASSURANCE

- A. Mold Resistance:
 - 1. Wall sheathing and roof boards shall receive a score of 10 indicating no mold growth detected in the category of mold and mildew resistance when tested in accordance with ASTM D3273.
- B. Standards:
 - 1. Wall sheathing and roof board shall meet or exceed ASTM C1177.
- C. Fire Performance, Wall Sheathing and Roof Board:
 - 1. Maximum flame spread – 10, maximum smoke developed – 0, when tested in accordance with ASTM E84.
 - 2. Non-combustible when tested in accordance with ASTM E136.
- D. Warranties:
 - 1. Wall Sheathing:
 - a. Wall sheathing shall have a 12-month exposure warranty.
 - b. Wall sheathing shall have a 5-year warranty against manufacturing defects.
- E. Compatibility:
 - 1. Wall sheathing and roof boards shall be compatible with materials specified in Division 7 which are to be installed directly to the sheathing and roof boards.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store and protect products under provisions on Section 01 60 00 – Product Requirements: Product storage and handling requirements.

- B. Delivery: Deliver materials to the job site in manufacturer's original packaging, containers and bundles with manufacturer's brand name and identification intact and legible.
- C. Store materials protected against damage from weather, direct sunlight, surface contamination, construction traffic or other causes. Stack sheathing and roof boards flat on leveled supports off the ground, under cover and fully protected from weather.
 - 1. Store and support sheathing and roof board in flat stacks to prevent sagging.
 - 2. Protect materials to keep them dry. Do not permit the entrapment of moisture or condensation.
 - 3. Protect gypsum board panels to prevent damage to edges, ends and surfaces.

PART 2 PRODUCTS

2.01 GLASS-FACED GYPSUM WALL SHEATHING

- A. Glass-Faced Sheathing: Composition, gypsum sheathing board core in accordance with ASTM C1177 with glass mats both sides and long edges.
 - 1. Products/Manufacturers:
 - a. DensGlass exterior sheathing/Georgia Pacific.
 - b. GlasRoc sheathing with EGRG technology/CertainTeed Gypsum, Inc. Securock glass-mat sheathing/USG.
 - c. eXP/National Gypsum.
 - d. Substitutions permitted: Product shall comply with ASTM C1177 and shall have been tested in accordance with ASTM D3273 and receive a value of 10, and requirements of this section.
 - 2. Thickness: 1/2 inch
 - 3. Size: 4'-0" by 8'-0"

2.02 ROOF BOARD

- A. Roof Board:
 - 1. Product/Manufacturer:
 - a. Georgia-Pacific DensDeck Prime with Eonic Technology: Verify in writing product is compatible with specified roofing membrane.
 - b. Substitutions permitted: Product shall comply with ASTM C1177 and shall have been tested in accordance with ASTM D3273 and receive a value of 10 and requirements of this section. Verify in writing product is compatible with specified roofing membrane.
 - 2. Thickness: 1/2 inch.
 - 3. Edges: Square.
 - 4. Size: 4'-0" by 8'-0"

2.03 ACCESSORIES

- A. Steel drill screws complying with ASTM C1002 for the following locations:
 - 1. Fastening glass-faced sheathing and roof board to steel members less than 0.033 inch thick.
 - 2. Fastening glass-faced sheathing and roof board to wood members using 1 ¼ inch bugle head coarse thread sharp point screw.
- B. Steel drill screws complying with ASTM C954 for fastening glass-faced sheathing and roof board to steel members from 0.033 to 0.112 inch thick.
- C. All fasteners shall be corrosion resistant. All fasteners and anchors used in contact with treated wood and in high humidity locations (lumber and plywood) shall be labeled as appropriate for use with the specified wood treatments and shall be:
 - 1. Stainless steel Type 304 or 316.
 - 2. Fasteners with proprietary anti-corrosion coatings may be submitted for use with treated wood. When submitted, the fastener manufacturer shall furnish specific information regarding the performance of their products in the specified treated wood and any precautions or special instructions that may be applicable.
 - 3. At non-preservative-treated and fire-retardant-treated locations, provide hot-dipped galvanized fasteners per ASTM A153, unless otherwise noted.

PART 3 EXECUTION

3.01 GLASS-FACED SHEATHING

- A. Glass-Faced Sheathing (Exterior Wall Sheathing)
 - 1. General: Provide glass-faced board sheathing in the cavity behind the stone/masonry veneer, behind metal wall and soffit panels, and where noted on the Drawings. Fasten to exterior heavy gauge stud framing using 1 1/4 inches, type S-12 bugle head self-tapping corrosion-resistant fine thread screw fasteners for 1/2 inch and 5/8 inch thick sheathing. For light gauge metal framing use 1 1/4 inches, Type S bugle head, corrosion-resistant sharp point, fine thread screws for 1/2 inch and 5/8 inch thick sheathing. Attach sheathing perpendicular (horizontal) to framing, with end joints staggered not less than one stud spacing. Abut ends of boards over centers of stud flanges. Keep perimeter fasteners 3/8 inch from edges and ends of board units. Fit boards tightly against each other and around openings.
 - 2. Install sheathing in accordance with manufacturer's instructions and applicable instructions in GA-253. Apply DensGlass gold side, side labeled USG Securock, CertainTeed GlasRoc or National Gypsum logo side out. Center end joints over supports and stagger in each course. Attach with screws to each support in accordance with manufacturer's recommended spacing, but provide not more than 8 inches o.c. at perimeter and 8 inches o.c. in the field. Drive fasteners to bear tight against and flush with surface of sheathing. Do not counter sink.

3.02 ROOF DECK BOARD

A. Roof Board

1. General: Provide roof deck board on the roof side of the parapets where the roof membrane is adhered to the roof board and locations noted on the Drawings. Install DensDeck Prime with green side out. Space fasteners a maximum of 8 inches o.c. around the perimeter and 8 inches o.c. in the field of the panel. Fasteners shall be approved by the board manufacturer. Panels shall be kept dry before, during and after installation. Install only as much roof board as can be covered by roof membrane system in the same day.

END OF SECTION

SECTION 06 41 16 – PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 GENERAL

1.01 SUMMARY

- A. Base and wall cabinets, laminated, factory finished.
- B. Countertops.
- C. Cabinet hardware.
- D. Preparation for installing utilities.
- E. Shelving.
- F. Definitions of Casework Items:
 - 1. Exposed Surfaces:
 - a. Exposed exterior surfaces, defined as all exterior surfaces exposed to view, include:
 - 1) All surfaces visible when doors and drawers are closed, including knee spaces.
 - 2) Underside of cabinet bottoms over 42 inches above the finished floor, including cabinet bottoms behind light valances and the bottom edge of light valances.
 - 3) Cabinet tops under 80 inches above the finished floor.
 - 4) Front edges of stretchers, ends, divisions, tops, and bottoms.
 - 5) Sloping tops of cabinets that are visible.
 - b. Exposed interior surfaces, defined as all interior surfaces exposed to view in open casework or behind transparent doors, include:
 - 1) Shelves, including edgebanding.
 - 2) Divisions and partitions (Front edge is an exposed surface).
 - 3) Interior face of ends (sides), backs and bottoms (including pull-outs). Also included are the interior surfaces of cabinet top members 36 inches or more above the finished floor.
 - 4) Interior face of door and applied drawer fronts.
 - c. Semi-exposed surfaces, defined as those interior surfaces only exposed to view when doors or drawers are opened, include:
 - 1) Tops and bottoms of shelves, including front edge banding (Front edge is an exposed surface).
 - 2) Divisions and partitions (Front edge is an exposed surface).
 - 3) Interior face of ends (sides), backs and bottoms (including a bank of drawers). Also included are the interior surfaces of cabinet top members 36 inches or more above the finished floor.
 - 4) Drawer sides, sub-fronts, backs and bottoms.
 - 5) The underside of cabinet bottoms between 24 inches and 42

- 6) inches above the finished floor.
- 6) Security and dust panels or drawer stretchers.
- d. Concealed surfaces, defined as those exterior or interior surfaces that are covered or not normally exposed to view include:
 - 1) Toe space unless otherwise specified.
 - 2) Sleepers, stretchers and solid sub-tops.
 - 3) The underside of cabinet bottoms less than 24 inches above the finished floor.
 - 4) The flat tops of cabinets 80 inches or more above the finished floor.
 - 5) The three non-visible edges of adjustable shelves.
 - 6) The underside of countertops, knee spaces and drawer aprons.
 - 7) The faces of cabinet ends of adjoining units that butt together.
- G. Cabinet Construction:
 - 1. Frameless construction where the front edge of the cabinet body components are edgebanded.
- H. Cabinet and door/drawer:
 - 1. Flush overlay, Figure 10-057 of the Architectural Woodwork Standards, 2nd Edition.

1.02 RELATED SECTIONS

- A. Section 06 10 53 – Miscellaneous Carpentry: Securing wall and floor mounted cabinets to wood blocking.
- B. Section 06 61 16 – Solid-Surfacing Fabrications.
- C. Section 09 90 00 – Painting and Coating: Field painting work station brackets.

1.03 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A156.9 - Cabinet Hardware.
 - 2. ANSI A208.2 – Medium-Density Fiberboard (MDF) for Interior Applications.
 - a. Medium-density fiberboard (MDF) panels with a formaldehyde-free adhesive system.
 - b. Moisture-resistant, medium-density fiberboard (MDF) panels with a formaldehyde-free adhesive system.
- B. Architectural Woodwork Institute:
 - 1. AWI – Architectural Woodwork Standards, Edition 2, October 1, 2014.
- C. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM D1037 – Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
 3. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- D. Federal Specification Unit:
1. FS A-A-1936 - Adhesive, Contact, Neoprene Rubber.
- E. National Electrical Manufacturers Association:
1. NEMA LD 3 - High Pressure Decorative Laminates.
- F. National Fire Protection Association:
1. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- G. Woodwork Institute:
1. WI - Manual of Millwork.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Submit product data for each type of product specified in this section and incorporated into items of casework.
- C. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location, and schedule of finishes.
 1. Show locations and sizes of furring, blocking and hanging strips specified in Section 06 10 53.
- D. Samples: Submit two 8-inch by 10-inch size samples, illustrating each cabinet finish specified.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with AWI Custom quality, as the minimum standard unless a higher standard of construction is specified throughout this specification.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle products to site under provisions of Section 01 60 00 – Product Requirements and AWI Section 2 – Care and Storage.

- B. Protect units from moisture damage.
- C. Environmental Conditions: Obtain and comply with woodwork manufacturer's and installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized from date of installation through remainder of construction period.

1.07 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Shop Drawings.

PART 2 PRODUCTS

2.01 HARDWOOD LUMBER

- A. Graded in accordance with AWI: Average moisture content of 6-8 percent, species yellow poplar, plain sawn.
- B. Graded in accordance with AWI: Average moisture content 6-8 percent, species yellow birch natural, plain sawn.

2.02 SHEET MATERIALS

- A. Medium-Density Fiberboard (MDF) Panels

- 1. Material:
 - a. Wood Fiber: 100 percent pre-consumer recycled wood residuals
 - b. Binder: Formaldehyde-free adhesive system.
- 2. Conformance: ANSI A208.2, industrial-grade MDF.
- 3. Panel Thickness: 3/4-inch.
- 4. Moisture Resistant: ASTM D1037, 6-cycle accelerated aging test.
- 5. Physical Properties:
 - a. Density: 48 pounds per cubic foot.
 - b. Internal Bond: 200 psi.
 - c. Modulus of Rupture: 6,000 psi.
 - d. Modulus of Elasticity: 600,000 psi.
 - e. Screw Holding: Required to pull 1-inch #10 sheet metal screw.
 - 1) Face: 350 lbs.
 - 2) Edge: 275 lbs.
 - f. Water Absorption: 5 percent average, 24-hour soak.
 - g. Thickness Swell: 3 percent average, 24-hour soak.
 - h. Linear Expansion: 0.30 percent, dimensional change in length and width due to humidity change.
 - i. Flame Spread: ASTM E84; Class C

- j. Moisture Content: 4 to 6 percent average, oven dry.
- k. Formaldehyde Emissions: 0.01 ppm

6. Manufacturer/Product:

- a. Sierra Pine/Medex complying with ANSI A208.2-2009 Grade 155, MR50 or approved equal per Section 01 60 00.

7. Use: Countertops and backsplash.

B. Medium-Density Fiberboard (MDF) Panels:

1. Material:

- a. Wood Fiber: 100 percent pre-consumer recycled wood residuals.
- b. Binder: Formaldehyde-free adhesive system

2. Conformance: ANSI A208.2 industrial-grade MDF.

3. Panel Thickness: 3/8-inch, 1/2-inch, 3/4-inch and 1 inch.

4. Physical properties, based on 3/4-inch thickness:

- a. Density: 48 pounds per cubic foot.
- b. Internal Bond: 150 psi.
- c. Modulus of Rupture: 5,500 psi.
- d. Modulus of Elasticity: 550,000 psi.
- e. Modulus of Hardness, Janka Ball: 1,150 pounds.
- f. Screw Holding: Required to pull 1 inch #10 sheet metal screw.

- 1) Face: 350 lbs.
- 2) Edge: 275 lbs.

- g. Water Absorption: 6.5 percent average, 24-hour soak.
- h. Thickness Swell: 3.5 percent average, 24-hour soak.
- i. Linear Expansion: 0.27 percent dimensional change in length and width due to humidity change.
- j. Flame Spread Rating: ASTM E84; Class C.
- k. Moisture Content: 6 percent average, oven dry basis
- l. Formaldehyde Emissions: 0.01 ppm.

5. Manufacturer/Product:

- a. Sierra Pine/Medite II complying with ANSI A208.2-2009 Grade 155 or approved equal per Section 01 60 00.

2.03 LUMBER

- A. Lumber Base: Preservative-treated lumber or preservative-treated 5-ply veneer core plywood.

2.04 MANUFACTURERS – PLASTIC LAMINATE

- A. Refer to finish schedule for manufacturer.

2.05 LAMINATE MATERIALS

- A. Plastic Laminate: High Pressure Decorative Laminate, NEMA LD3, Current Edition, for type; color, pattern, and finish indicated.
 - 1. General Purpose, Horizontal and High Usage Exposure: NEMA Standard HGS, nominal thickness 0.048 inches.
 - 2. General Purpose, Vertical and Medium Usage Exposure: NEMA Standard VGS, nominal thickness 0.028 inches.
 - 3. Cabinet Liner: NEMA Standard CLS, nominal thickness 0.020 inches.
 - 4. Unfinished Backing Sheet: NEMA Standard BKL, nominal thickness 0.020 inches.
- B. Thermoset Decorative Overlay: Decorative surfaces of thermally fused polyester or melamine impregnated web, pre-laminated to specified substrate and complying with Composite Panel Association.
 - 1. Substrate: Medium-density fiberboard.
 - 2. Interior Finish Color:
 - a. White.

2.06 ACCESSORIES

- A. Contact Adhesive and Sealants: As recommended by fabricator.
- B. MDF water proof edge sealer:
 - 1. Two- part epoxy system as manufactured by The West System.
 - a. Part A, West System 105 Epoxy Resin.
 - b. Part B, West System 206 Slow Hardener.
- C. Edging: High-pressure laminate and 3mm PVC, as noted.
- D. Cable Grommet with 90-Degree Rotating Top: Hafele 60 mm diameter opening, Cat. No. 631.26.301, color black.
- E. Fasteners: Size and type to suit application.
 - 1. To secure base cabinets to preservative treated wood, use hot-dipped galvanized fasteners complying with ASTM A153 or Type 304 or 316 stainless-steel fasteners.
- F. Bolts, Nuts, Washers, Lags, Pins and Screws: Of size and type to suit application; finish in exposed locations. Shall match finish of hardware. **Note:** The use of drywall screws is not permitted. Use heavy shank steel screws.
- G. Concealed Joint Fasteners: Threaded steel.
- H. Dowels: Minimum 5/16 inch by 1 3/16 inches.

I. Dowel Screw: Minimum 9/32 inch by 2 inches.

J. Biscuits: #30.

2.07 HARDWARE

A. Hardware: Shall conform to ANSI/BHMA A156.9, "American National Standard for Cabinet Hardware" and BIFMA, "Business and Institutional Furniture Manufacturers' Association," Current Edition.

B. Shelf Supports for 5mm Hole: Knappe and Vogt #345 NP.

1. Shelf support shall meet ANSI/BHMA A156.9 Grade 1 requirements and test standard.

C. Wire Drawer and Door Pulls: Stanley #4484-US26D, 4 inch.

D. Hinges: European style conforming to ANSI/BHMA A156.9 Grade 1 performance and permanent set test requirements and as follows:

1. 170-degree opening.

2. Self-closing

3. All metal construction.

4. Use two per door for doors up to 36 inches high, three per door for doors up to 60 inches high, four per door for doors up to 80 inches high.

5. Provide screws as recommended by hinge manufacturer appropriate to specified panel product.

E. Cabinet Locks: Olympus Lock, Inc., Deadbolt Locks.

1. Cabinet door lock:

a. Olympus 721DR (door) Cabinet locks: Locks to accept 6 or 7 pin small format interchangeable core cylinders as supplied by Best, Arrow, Falcon, KSP or equivalent. Verify with District. All locks to be field reversible and to provide dedicated door functions in order to maintain keyway verticality when installed. Include strikes and spacers as required for flush fit with outside face of casework material. Locks will provide disassembly/reassembly features to facilitate on-the-job maintenance. Unless noted otherwise provide one lock at each cabinet door and drawer.

b. Function: Key removable in locked or unlocked position.

c. Cylinder length: 1 3/8 inches.

d. Finish: US26D.

e. Keying: Keyed to room in which locking cabinet is located, unless otherwise noted.

- 1) Verify with District.
2. Cabinet drawer lock:
 - a. Olympus 721DW (drawer) Cabinet locks: Locks to accept 6 or 7 pin small format interchangeable core cylinders as supplied by Best, Arrow, Falcon, KSP or equivalent. Verify with District. All locks to be field reversible and to provide dedicated door and drawer functions in order to maintain keyway verticality when installed. Include strikes and spacers as required for flush fit with outside face of casework material. Locks will provide disassembly/reassembly features to facilitate on-the-job maintenance.
 - b. Function: Key removable in locked or unlocked position.
 - c. Cylinder length: 1 3/8 inches.
 - d. Finish: US26D.
 - e. Keying: Keyed to room in which locking cabinet is located, unless otherwise noted.
 - 1) Verify with District.
 3. Unless noted otherwise provide one lock at each cabinet door and drawer.
- F. Spring-Loaded Elbow Catch: H'A'FELE #245.74.200. Provide one catch on the inactive leaf of each pair of doors noted to be locked.
- G. Drawer Slides:
1. All drawer slides shall be tested in accordance with ANSI/BHMA A156.9 and in accordance with BIFMA standards.
 2. Box and File Drawers: Accuride 7432, 100 lb. load rating, side mounting, steel ball bearing, full extension, for drawer widths up to 24 inches wide and drawer depths deeper than 6 inches.
 - a. Finish: Clear zinc (ROHS compliant)
 3. Large Storage, Lateral Files: Accuride 3640, 200 lb. load rating, side mounting, steel ball bearing, over travel, for drawer widths 24 inches to 42 inches.
 - a. Finish: Clear zinc (ROHS compliant)
- H. Magnetic Catch: Knape & Vogt 918 ALUM.
- I. Door and Drawer Bumpers: Clear plastic bumpers.
- J. Surface Bolts: Provide two on the inactive leaf of the 3'-0" by 7'-0" casework units.
- M. Concealed Flat Brackets: A&M Hardware, Inc.
1. Extended Concealed Flat Brackets:

- a. ½ inch steel.
 - b. 26 inches by 26 inches, 2.0 ECFLAT24
 - c. Load to deformation (lbf): 1,700 per pair.
Color: Black.
Maximum spacing: 36 inches on center.
2. Concealed Flat Brackets:
- a. ½ inch steel.
 - b. 26 inches by 18 inches, 2.0 CFLAT24
 - c. Load to deformation (lbf): 1,150 per pair.
 - d. Color: Black.
 - e. Maximum spacing: 36 inches on center.

2.08 FABRICATION

- A. Casework, Laminate: Shall conform to the design and details shown of the Drawings, and shall meet the requirements for casework as defined in the Architectural Woodwork Standards current edition, Section 10 – Casework, for Custom Grade woodwork for laminate finish.
1. Construction Style:
 - a. Flush Overlay Style: Provide base, wall and full height units with drawer fronts, doors and fixed panels (if any) overlaying and concealing frames and sides of cabinet bodies, Architectural Woodwork Standards, Construction Frameless – Flush Overlay.
 2. Cabinet Construction:
 - a. Laminate Cabinets: Laminate facings conforming to Architectural Woodwork Standards, Section 10 – Casework.
 - 1) Exposed exterior surfaces finish: High-pressure decorative laminate as specified.
 - 2) Exposed interior surfaces finish: High-pressure decorative laminate as specified, matching color of exposed exterior laminate unless noted otherwise.
 - 3) At inside face of door and drawer fronts: Same material and thickness as the face.
 - 4) Semi-exposed surfaces finish:
 - a) Thermally fused melamine
 - 5) Drawer sides, back and sub-fronts:
 - a) Minimum thickness: 1/2-inch.
 - b) Material: Single-species solid lumber.
 - b. Joinery and Fastening of Case Body Members. Refer to Architectural Woodwork Standards, Section 10. Case body members shall be joined in accordance with Architectural Woodwork custom grade standards as listed below:

- 1) Exposed Ends (finished ends on casework shall be integral, not applied secondarily): Rabbeted or plowed to receive backs. Horizontal members, excluding countertops shall not extend beyond the exposed ends.
- 2) Concealed Ends: Rabbeted or plowed to receive backs.
- 3) Cabinet Backs: Where non-plowed/dadoed in housed shall be screwed to the case body, divisions and/or fixed shelves at a maximum of 4 inches on center.
- 4) Cabinet Backs: Where plowed-in with a minimum shoulder of 3/8 inch shall be securely nailed or stapled to the case body at a maximum of 4 inches on center.
- 5) No nails, screws or other fastenings may be visible on exposed or semi-exposed surfaces.
- 6) Rails or top panels must be provided where case will have a separate top, in order to permit concealed fastening of the separate top through such rails.
- 7) Anchor Strips: Minimum 1/2-inch-thick lumber or panel product, minimum 2-1/2-inches width; securely glued and mechanically attached to cabinet body members at 4 inches on center on the wall side of the cabinet back-top and bottom for wall hung and floor mounted standing cabinets. Cabinet heights over 60 inches require an intermediate anchor strip.

c. Component Construction: Wall and base cabinet.

- 1) Doors: 3/4-inch thick MDF with VGS high-pressure plastic laminate on both sides. At tall cabinets provide 1-inch MDF with VGS high-pressure plastic laminate on both sides. **Note:** Laminate face side and thermoset decorative overlay back side not permitted on doors. Apply laminate to both faces in the same machine direction.
 - a) Edging: 3 mm PVC.
 - b) No cabinet door shall be more than 24 inches wide and 84 inches high.
 - c) Stop silencers to be installed at the top and bottom of all hinged doors on the closing edge.
 - d) Doors shall stop, as applicable, against the cabinet body at the bottom, sides and top stretcher. At paired doors below a drawer, a rail, stretcher or partition shall be provided.
 - e) Locking pairs:
 - i. Provide an elbow catch on the inactive leaf and a stop block. The stop block shall be adequate to prevent the latch of the elbow catch/latch from being defeated by applying pressure on the door.
 - ii. Full height doors with a fixed mid-height shelf shall have an elbow catch/latch on the inactive leaf of the fixed shelf.
 - iii. Full height doors without fixed shelf shall have a surface-mounted slide bolt.

- 2) Drawer Fronts: 3/4-inch thick MDF with VGS high-pressure plastic laminate on both sides. **Note:** Laminate face side and thermoset decorative overlay back side not permitted on drawers.
 - a) Edging: 3 mm PVC.
 - b) Secure to drawer box sub-front with pan/binder head, countersunk flathead or oval head screws with a minimum of two screws at each end a maximum of 1 1/2-inches from inside corners of the drawer box and a maximum of 12 inches on center.
 - c) False fronts shall be securely attached to the cabinet body.
- 3) Exposed End Panels: 3/4-inch thick MDF thermally fused melamine panel with VGS high-pressure laminate on exposed face. Where exposed end panel surfaces are exposed to view (interior and exterior), provide VGS high-pressure laminate on both surfaces.
 - a) Edging: VGS high-pressure laminate on exposed edge.
- 4) Concealed end panels (Faces of cabinet ends of adjoining units that butt together): 3/4-inch thick MDF thermally fused melamine panels at semi-exposed side. At exposed end, provide VGS high-pressure plastic laminate.
 - a) Edging: 3 mm PVC on exposed surfaces.
- 5) Division Panels: 3/4-inch thick MDF.
 - a) At semi-exposed surfaces provide thermally fused melamine on both faces.
 - b) At exposed surfaces provide VGS high-pressure laminate on both sides.
 - c) Edging: 3 mm PVC on exposed edges.
- 6) Base Cabinet Bottoms: 3/4-inch thick MDF thermally fused melamine panels at semi-exposed panels. At exposed panels provide HGS high-pressure laminate.
 - a) Edging: 3 mm PVC on exposed surfaces.
- 7) Tops of Wall-Hung Cabinets and Tall Cabinets: 3/4-inch thick MDF thermally fused melamine panels at semi-exposed panels. At exposed panels provide VGS high-pressure laminate.
 - a) Edging: 3 mm PVC on exposed edges.
- 8) Bottoms of Wall-Hung Cabinets: 3/4-inch thick MDF thermally fused melamine panels at semi-exposed panels. At exposed panels provide HGS high-pressure laminate.
 - a) Edging: 3 mm PVC on exposed edges.
 - b) When unsupported do not exceed 48 inches in length. Over 48 inches provide center support.

- 9) Security and Dust Panels: 1/2-inch thick MDF.
 - a) Furnish above locked doors and drawers, only if each drawer or door is keyed differently.
 - b) Where front and rear stretchers are provided, the panel may be 1/4-inch thick and let into the stretchers.

- 10) Stretchers (Only Required to Base Cabinets with Separate Countertops) Coordinate with Section 06 61 16 – Solid Surfacing Fabrications for countertop supports:
 - a) Solid stock: 3/4-inch thick by 2 inches wide.
 - b) MDF: 3/4-inch thick by 5 inches wide, reinforced as necessary to support the countertop.
 - c) Provide stretchers at both the front and back of the cabinet body except at sink compartments, which may run front to back.
 - d) In lieu of stretchers a panel member of 3/4-inch MDF specified for use in counters or 3/4 inch, minimum 5 ply veneer core plywood with Type I adhesive which runs the full length and depth of the cabinet opening may be used.
 - e) At drawer banks where the total drawer opening height exceeds 30 inches provide an intermediate front stretcher.

- 11) Drawer Boxes (Sides, Backs, Sub-Fronts): 1/2-inch thick, single-species solid hardwood lumber with a hardness rating of medium or better per Appendix B, Section 3 – Lumber of the standards, factory finished with minimum one seal coat and one top coat, sides, backs and sub-fronts. Joints to be doweled and glued under pressure. Provide a minimum of two per joint. Dowels shall be spaced a maximum 1 1/4-inches on center for joints up to 4 inches in length and 2 1/2-inches on center for joints over 4 inches in length. Optional fastening methods include multiple-dovetailed or biscuit-joined under pressure. Biscuits shall be spaced a maximum of 3 inches on center, minimum two per biscuits per joint. All joints shall be securely glued.

- 12) Drawer Bottom: Minimum 1/4-inch thick MDF thermally fused melamine panels, balanced.
Note: Where drawer exceeds 30 inches in width, or bottom-mount hardware is required, the drawer bottom shall be a minimum of 1/2-inch thick MDF thermally fused melamine panels, balanced. The drawer bottom shall be plowed into drawer sides, back and sub-fronts 1/4-inch, and securely glued to form a rigid unit. Provide a minimum 3/8-inch standing shoulder on sides, back and sub-front.

- 13) Drawer Hardware, Locks:
 - a) Drawer slides to operate smoothly.
 - b) Provide closing stops at the rear of both drawer sides, unless such is built into the slides to prevent the drawer from impacting the cabinet body.
 - c) Spring-loaded tip-down stop to be provided (design permitting) to prevent the drawer from pulling out of the cabinet, unless such is built into the drawer slides.

- d) At locked banks of drawers where each drawer is keyed differently provide security or dust panels. Coordinate with locks specified in the hardware section of this specification.
 - e) At file drawers, provide clear inside height sufficient for hanging file folder tabs. Provide either a system stand or rails. At legal-sized drawers with hanging file suspension bars provide both legal- and letter-sized files.
- 14) Base and Wall Cabinet Back: 1/4-inch thick MDF. At exposed surfaces provide VGS high-pressure laminate, panels balanced. At semi-exposed surfaces provide thermally fused melamine panels.
- 15) Aprons: 3/4-inch thick MDF with VGS high-pressure plastic laminate on both sides.
- a) Edging at bottom: 3 mm PVC.
- 16) Fixed Shelves: 3/4-inch thick MDF thermally fused melamine panels at semi-exposed surfaces. At exposed surfaces provide MDF with HGS high-pressure laminate.
- a) Edging: 3 mm PVC.
 - b) Shelves shall be fixed to ends, dividers and backs.
 - c) Shelves over 30 inches in length shall have a center support.
- 17) Adjustable Shelves: 3/4-inch thick MDF for spans up to 31 inches, 1-inch thick MDF for spans up to 39 inches. At semi-exposed shelves provide HGS high-pressure laminate. At exposed surfaces provide HGS high-pressure laminate.

NOTE: Thickness and span of shelves are based on the following:
Load: 50 lbs. per sq. ft.
Maximum load of 200 lbs applied uniformly on any shelf.
Maximum deflection: 1/4 inch.
MOE of material with vertical grade HPDL on both sides:
Minimum 550,000.

- a) Edging: 3 mm PVC.
- b) Width of shelf, maximum 1/8 inch less than inside cabinet width except where shelf-support clips require notching. Ends may exceed 1/8 inch provided both ends are banded and the total clearance between shelf clips is a maximum of 1/8 inch.
- c) Shelves shall be supported on cleanly bored holes at a maximum of 2 inches on center with shelf rests.
 - i. Centerline of rests shall not exceed a minimum of 1 inch to a maximum of 4 inches from the front and back of cabinet body.
 - ii. Support placement shall not conflict with hinge placement.
 - iii. Dimension between the centerline of the rest shall not be less than 60

- iv. percent of the shelf depth.
Shelves over 29 3/4-inches deep provide 3 supports at each end.
- v. Bored shelf hole support systems shall extend vertically to within 6 inches of the interior top or bottom of the cabinet.

18) Toe Kick: 3/4-inch-thick preservative-treated plywood.

d. Countertops (Plastic Laminate):

- 1) Exposed surfacing material: HGS high-pressure laminate.
- 2) Substrate: 3/4 MDF. Refer to 2.02, A, for product. Seal all edges of MDF at sink cutout with two-part epoxy water-proof sealer. Sand MDF with an 80-grit sandpaper prior to applying sealer. Apply water-proof sealer in three coats.
- 3) Nominal thickness at edge 1 1/2-inches.
- 4) Provide standard unfinished backing sheet BKL.

a) Front edge: 3 mm PVC.

e. Backsplash and Sidesplash (Plastic Laminate):

- 1) Exposed surfacing material: HGS high pressure laminate.
- 2) Substrate: 3/4-inch thick MDF. Refer to 2.02, A, for product.
- 3) Exposed Ends: HGS high-pressure laminate.
- 4) Backside of all splashes shall have a backing sheet.
- 5) Assembly 1, wall mount, jobsite assembled.
- 6) Seal all surfaces not covered with plastic laminate with water proof sealer in three coats. Sand MDF with an 80 grit sandpaper prior to applying sealer.

- B. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- C. Install edging as specified in one piece for full length of component.
- D. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- E. Apply plastic laminate finish in full uninterrupted sheets. Fit corners and joints hairline; securing with glue and concealed bolt type fasteners. Locate counter butt joints minimum 2 feet from edge of sink cutouts.
- F. Cutouts in plastic laminate countertops shall have a minimum 1/4-inch radius at all inside corners.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

- A. Install casework plumb, level, true and straight with no distortions. Shim as required using concealed shims. Install to a tolerance of 1/8 inch to 8 feet 0 inches for plumb and level (including tops); and with no variations in flushness of adjoining surfaces.
- B. Scribe and cut casework to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- C. Anchor casework to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Attach countertops securely to base units.
 - 1. Casework Wall Anchorage:
 - a. Continuous Blocking or Backing: Provide minimum 2-inch by 6-inch nominal wood or 6-inch by 16-gauge metal track notched at each stud at locations shown on the casework Shop Drawings. Coordinate with Section 06 10 53 for plate used with 2 by 6.
 - b. Anchorage fasteners shall be neatly installed through the back and anchor strip, at the top and bottom of each cabinet body (wall hung and base cabinets) and at intermediate height of cabinets over 60 inches tall.
 - c. Fastener to be a minimum 3-1/2-inch by #10 diameter screw with a surface-bearing head. Achieve a minimum of 1-1/2-inch penetration into the wall studs, blocking or masonry. The use of drywall or bugle-head screws is prohibited.
 - d. Exposed interior surfaces require screws capable of being recessed and covered with matching cover caps.
 - e. Each cabinet unit (wall and base unit) or undivided span shall have a minimum of four anchorage fasteners, two at the top and two at the bottom subject to:
 - 1) A maximum spacing of 16 inches on center, except wall cabinet units over 48 inches in height shall be 12 inches on center.
 - 2) Install fasteners vertically within 2 inches of the outside top and bottom of the cabinet and within 2 inches horizontally of the outside end.
 - 2. Adjoining cabinets: Adjacent cabinets shall be fastened together at the front with a minimum of two #8 by 1-1/4-inch flat, oval or pan-head screws a maximum of 30 inches on center and at exposed interior surfaces, fasteners shall be countersunk and covered to match the surface.
- D. Install casework without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
- E. Grommets shall be provided at all locations designated by the Owner. Do not install grommets until the Owner has approved the location.
- F. Provide cutouts for plumbing fixtures, and appliances as indicated. Smooth cut edges and coat with waterproof coating or adhesive.
- G. Apply a continuous bead of silicone sealant to the joint between the countertop and splash.
- H. Provide all brackets as shown on Drawings.

- I. Adjustable Shelf Supports: Two vertical rows of 5 mm diameter holes spaced at 2 inches on center.
- J. Countertop overhangs shall be consistent with a minimum of 1/2-inch and a maximum of 1-1/4-inch of cabinet face and/or finish end.
- K. Unsupported countertop spans shall not exceed 36 inches and shall be reinforced to prevent deflection in excess of 1/4-inch under a 50 lb. per square foot load.
- L. Laminations to countertops shall be made securely with Type II adhesive.
- M. Built-up members for plastic laminate countertops shall be MDF material.
- N. Backsplashes require end splashes at walls.
- O. At Assembly 1, wall mount backsplash and end-splash:
 - 1. Top edge to be banded.
 - 2. Front edge of end-splash to be banded.
 - 3. All splash components shall be securely adhered to the wall, butt-joined to the countertop and shall be caulked with a clear waterproof caulking so as to leave a visual bead not exceeding 1/8 inch between the bottom of the splash and the countertop.
- P. Base cabinets not installed on a wood base: Seal any portion of the MDF core in contact with the floor using the water proof sealer specified in this section.

3.03 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00 – Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean work under provisions of Section 01 70 00 – Execution and Closeout Requirements: Final cleaning.
- B. Clean casework, counters, shelves, hardware, fittings and fixtures.
- C. Protect surfaces from damage. Repair or replace damaged work that cannot be repaired to Architect's satisfaction.

3.05 PLASTIC LAMINATE SCHEDULE

- A. Refer to Drawings for location, color and manufacturer of plastic laminate.

END OF SECTION

SECTION 06 60 00 – SOLID POLYMER FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 specification sections, apply to this section.

1.02 SUMMARY

- A. This Section Includes the Following:
 - 1. Solid polymer fabrications in vertical applications.
- B. This Section Includes the Following:
 - 1. Partitions
- C. The extent of solid polymer fabrications is shown on the Drawings.

1.03 SUBMITTALS

- A. Product Data: Indicate product description, fabrication information and compliance with specified performance requirements.
- B. Shop Drawings: Include plans, elevations, sections, details and attachments to other work.
- C. Samples for Initial Selection:
 - 1. Submit minimum 4 inch by 4 inch samples. Indicate full color and pattern variation.
- D. Samples for Verification:
 - 1. Submit minimum 6 inch by 6 inch sample for each type, texture, pattern and color of solid polymer.
- E. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.04 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Provide original fire test reports to ensure compliance with the following requirements:
 - 1. Rate of Burning:
 - a. ASTM D635 Class: CC1 for a nominal thickness of 1.5 mm (0.060 in.)
 - 2. Self-Ignition Temperature:

- a. ASTM D1929: greater than 650 degrees F
3. Density of Smoke:
 - a. ASTM D2843: Less than 75%
4. Flammability Classification:
 - a. ASTM E84: Smoke less than 450, Flame spread less than 75.
- B. Impact Resistance: Provide Solid Polymer Fabrications that comply with the following requirements:
 1. Impact Strength, Un-notched (23 degrees), ASTM D4812: No breakage.
 2. Impact Strength, Notched (23 degrees), ASTM D526: 88J/m (1/16).
- C. Allowable Tolerances:
 1. Maximum deflection: 1/16 inch over 12 inches.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver solid polymer fabrications, system components and accessories to Project site until areas are ready for installation
- B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.
- C. Before installing solid polymer fabrications, permit them to reach room temperature.

1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install solid polymer fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.07 WARRANTY

- A. Manufacturer's Special Warranty on Solid Polymer Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.
- B. Warranty Period: 1 year after the date of substantial completion.
- C. The warranty shall not deprive the owner of other rights or remedies the Owner may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Product: The design of solid polymer fabrications is based on Varia™ as provided by 3-Form, Inc. Products from other manufacturers must be approved by the Architect prior to bidding in accordance with the Instructions to Bidders and Section 01 60 00 – Product Requirements.
 - 1. Fire-test-response characteristics noted in Part 1 must be substantiated with original test results for manufacturers' products. Generic tests, which do not specifically refer to manufacturer, will not be accepted.
- B. Provide products specified in each solid polymer fabrication product data sheet at end of this Section.

2.02 MATERIALS

- A. EcoResin™ Resin Sheet
 - 1. Engineered polyester resin, Glycol modified.
 - 2. Sheet Size: Maximum 4 feet by 10 feet.
 - 3. Thickness: Minimum 1/16 inch.
- B. Interlayer Materials: Compatible with polyester and bonding process to create a monolithic sheet of material when complete.

2.03 FABRICATION

- A. General: Fabricate solid polymer fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the Drawings.
- B. Comply with manufacturer's written recommendations for fabrication.
- C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.
 - 1. Sawing: Select equipment and blades suitable for type of cut required.
 - 2. Drilling: Drills specifically designed for use with plastic products.
 - 3. Milling: Climb cut where possible.
 - 4. Routing.
 - 5. Tapping.
 - 6. Shearing and Punching: Acceptable only on 1/16-inch material.
 - 7. Die Cutting: Acceptable only on material 1/8 inch or less.
- D. Forming: Form products to shapes indicated using the appropriate method listed below.

Comply with manufacturer's written instructions.

1. Cold bending.
 2. Hot bending.
 3. Thermoforming: Acceptable only on uncoated material.
 4. Drape forming.
 5. Matched mold forming.
 6. Mechanical forming.
- E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

2.04 MISCELLANEOUS MATERIALS

- A. General: Provide products of material, size and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaner: Type recommended by manufacturer.
- C. Fasteners: Use screws designed specifically for plastics. Self-threading screws are acceptable for permanent installations.
- D. Bonding Cements: Solvent or adhesives, suitable for use with product and application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas and conditions where installation of solid polymer fabrications will occur, with installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.02 INSTALLATION

- A. General: Comply with manufacturer's written instructions for the installation of solid polymer fabrications.
- B. Shop fabricates items to the greatest degree possible.
- C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.
- D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved Shop Drawings and product data.

- E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.

3.03 CLEANING AND PROTECTION

- A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

END OF SECTION

PRODUCT DATA SHEET 1 – Solid Polymer Fabrication #1 (SPF-1)

Product: [Replace with Collection and product name]

Color: [Replace with color name]

Gauge: [1/16 inch] [1/8 inch] [3/16 inch] [1/4 inch] [3/8 inch] [1/2 inch] [3/4 inch] [1 inch] [As indicated on Drawings] [As required to meet deflection requirements]

Surface Finish: [Patent] [Patent and Hardcoat] [Patina] [Pixel] [Sandstone] [SFX Frost] [Stucco] [Supermatte]

UV Protection: [required] [not required]

Expansion/Contraction Allowance:

Edge Seal: [not required] [required]

Orientation: [Horizontal] [Vertical]

SECTION 06 61 16 – SOLID SURFACING FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes cast plastic fabrications as shown in the List of Finishes and shown on the drawings.
- B. Related Sections:
 - 1. Section 06 41 16 – Plastic-Laminate-Clad Architectural Cabinets. At counters build up the thickness using core panel members specified in this section below the solid surface counter.
 - 2. Section 22 40 00 - Plumbing Fixtures: Plumbing drains and fixture trim.

1.02 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- C. Underwriters Laboratories Inc.:
 - 1. UL - Fire Resistance Directory.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings: Indicate dimensions, thicknesses, required clearances, tolerances, materials, colors, finishes, fabrication details, field jointing, adjacent construction, methods of support, integration of plumbing components, and anchorages.
- C. Product Data: Submit data on specified component products, electrical characteristics and connection requirements.
- D. Samples: If colors are indicated on Drawings, submit an 8-inch-square sample of each selected color. If colors are not indicated on Drawings, submit manufacturer's standard color book showing colors of actual material in 2-inch by 2-inch size.
- E. Manufacturer's Instructions: Submit complete manufacturer's fabrication and installation instructions.
- F. Maintenance Instructions: Upon completion, furnish the Owner one set of manufacturer's recommended cleaning procedures.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit list of approved cleaning materials and procedures required; list of substances harmful to component materials. Include instructions for stain removal and surface and gloss restoration.

1.05 QUALITY ASSURANCE

- A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Installation of solid surfacing materials shall be by a firm that is authorized by solid surfacing manufacturer to fabricate and install solid surfacing materials, and that can demonstrate successful experience in installing finished carpentry items similar in type and quality to those required for this project.

1.07 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.
- B. Verify field measurements are as indicated on Shop Drawings.

1.08 SEQUENCING

- A. Sequence Work to permit installation of adjacent affected construction, plumbing rough-in.

1.09 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish ten-year manufacturer warranty for each type of unit.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Transport and handle sheets and fabricated items by methods that will prevent damage and defacing.
- B. Storage: If units are not installed immediately upon delivery to site, store in covered location, off the ground or floor, and cover with moisture- and stain-resistant paper or plastic.

1.11 ENVIRONMENTAL CONDITIONS

- A. Obtain and comply with solid surfacing manufacturer's recommendation for optimum temperature and humidity conditions for solid surfacing material during its storage and

installation.

1.12 MAINTENANCE

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two containers of 16 ounces of polishing cream.

PART 2 PRODUCTS

2.01 MATERIAL

- A. General: Solid surfacing material shall be non-porous, homogenous blend of polyester or acrylic alloys and fire fillers to create a material that cuts like wood. The color and pattern shall extend throughout the material. The material shall be in 1/4-inch, 1/2 inch or 3/4 inch thickness as indicated, in one piece wherever possible.

2.02 MANUFACTURER/COLOR

- A. Refer to Finish Schedule for manufacturer and color.
 - 1. Finish:
 - a. Satin.

2.03 FABRICATION AND INSTALLATION MATERIALS

- A. Joint Adhesive: Type recommended by manufacturer, in color to match solid surface material.
- B. Mildew-Resistant Silicone Sealant: FDA/UL sealant as recommended by manufacturer, in colors matching components.
- C. Contact Adhesive: Type recommended by manufacturer for adhering solid surface to base cabinets and counters.
- D. Concealed Flat Brackets: A&M Hardware, Inc.
 - 1. Extended Concealed Brackets:
 - a. 1/2 inch steel.
 - b. 26 inches by 26 inches, 2.0 ECFLAT24
 - c. Load to deformation (lbf): 1,700 per pair.
 - d. Color: Black.
 - e. Maximum spacing: 36 inches on center.
 - 2. Concealed Brackets:
 - a. 1/2 inch steel.
 - b. 26 inches by 18 inches, 2.0 CFLAT24

- c. Load to deformation (lbf): 1,150 per pair.
- d. Color: Black.
- e. Maximum spacing: 36 inches on center.

2.04 FABRICATION

- A. Solid surface materials shall be fabricated by an authorized solid surface fabricator.
- B. Solid surface countertops shall be the thickness indicated, one piece wherever possible, and with flush joints sealed with joint adhesive where required. Solid surface manufacturer shall guarantee color match within the crate. Follow solid surface manufacturer's standard "Color Matching" procedures when joining sheets from outside the crate. Shop shall fabricate in the largest sections possible for transporting and building access.
- C. Ease top and front edges and corners only if shown on drawings.
- D. Solid surface materials shall be fabricated to field measurements. Seams shall be located where shown on approved Shop Drawings. Provide seam blocks under all seams where necessary in accordance with manufacturer's recommendations.
- E. Edge detail shall be as selected by Architect.
- F. Backsplash height shall be according to detail provided.
- G. Backsplashes shall be field-installed, with tight, sealed joints, unless otherwise noted.
 - 1. Coves: Provide shop-fabricated integrally molded coves at back and ends where against walls or other vertical surfaces, with 3/8-inch radius between top and splash only if shown on drawings.
 - 2. Finish of exposed surfaces shall be (satin) according to the methods prescribed by the manufacturer.
- H. Sinks shall be selected from manufacturer's standard sink designs and colors and shall be formed integrally into countertops.
- I. Cutouts for sinks furnished by others shall be smooth and uniform without saw marks. The top and bottom of sink openings shall be finished smooth. Corners of sink cutouts must be a minimum of 1/4-inch radius.
- J. Full underlayment: At wall hung counters, base cabinets with or without sinks provide the following core material for solid surface counters:
 - 1. 3/4 inch exterior grade veneer core plywood with waterproof adhesive, minimum 5 ply, fir or poplar.
 - 2. Provide full underlayment only at locations where cooking does not take place.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that counters and supports are suitable for installation in accordance with Shop

Drawings.

3.02 INSTALLATION

- A. Install tops in locations indicated, conforming to manufacturer's recommended installation procedures. Set tops on supports and anchor using fasteners shown on approved submittals.
- B. Use silicone sealant for attaching backsplashes and reveal edges. Seal all joints with sealant.
- C. Field joints shall be hard-seamed unless otherwise specified.

3.03 CLEANING

- A. At completion of work, remove all excess material, dirt, dust, trash and other materials resulting from the installation. Clean surfaces of solid surface materials, remove all labels and leave the area clean.

3.04 PROTECTION

- A. Provide suitable protection on counter, to protect the installation from damage until final acceptance. Place temporary covers over sinks to preclude their use for construction purposes.

3.05 SCHEDULE

- A. Refer to "List of Finishes" and drawings for location of solid surface materials indicated by SS.

END OF SECTION

SECTION 07 11 13 – BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cold-applied, water-based asphalt emulsion damp-proofing for planter walls.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete.

1.03 REFERENCES

- A. ASTM

1. ASTM D1187 – Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
2. ASTM D1227 – Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

1.04 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide material complying with the following requirements:

1. Nonflammable.
2. VOC Content:
 - a. 0.25 pounds per gallon (30g/L) less water and exempt solvents.
3. Service Temperature Range:
 - a. Minus 40 degrees F (minus 40 degrees C) to 150 degrees F (66 degrees C).
4. Compliance:
 - a. Trowel-applied long fiber reinforced complying with ASTM D1227, Type 2, Class I and ASTM D1187, Type 1.

1.05 SUBMITTALS

- A. Submit Under Provisions of Section 01 33 00.
- B. Product Data: Provide properties of primer, bitumen, mastics, technical bulletins and MSDS on each product.
- C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with NRCA Waterproofing Manual.

1.07 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum 3 years of documented experience.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Comply with Section 01 60 00.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Store tightly sealed materials off ground and away from moisture, direct sunlight, extreme heat and freezing temperatures.

1.09 PROJECT CONDITIONS

- A. Environmental Requirements:
 - 1. Keep from freezing in the container.
 - 2. Do not apply at temperatures below 40 degrees F (4 degrees C) or when temperatures are expected to fall to 40 degrees F (4 degrees C) within 24 hours.
 - 3. Protect from rain until coating has set.
 - 4. Application shall be protected or covered within 7 days of application.
 - 5. Do not expose to long-term UV.

PART 2 PRODUCTS

2.01 MANUFACTURERS – BITUMINOUS DAMPPROOFING

- A. Karnak Chemical Co., #920 AF Fibrated Coating.
- B. BASF Building Systems, Masterseal 614.
- C. Substitutions: Under provisions of Section 01 60 00.

2.02 COLD ASPHALTIC MATERIALS – BITUMINOUS DAMPPROOFING

- A. Asphalt Emulsion: Asphalt-and-water-emulsion coating, compounded to penetrate substrate and build to moisture-resistant coating. Coating shall be fibered asphalt emulsion, non-asbestos compound, complying with ASTM D1227, Type II, Class I, and ASTM D1187, Type I.

1. Manufacturers/Products: Provide and install one of the products listed in 2.01 manufacturers.
- B. Protection Board:
 1. Manufacturers/Products:
 - a. Dow Chemical Company/Protection Board III
 - b. Owens Corning/Fanfold DWB Dampproofing Waterproofing Board

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
- B. Verify items which penetrate surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

- A. Protect adjacent surfaces not designated to receive dampproofing.
- B. Clean and prepare surfaces to receive dampproofing and waterproofing in accordance with manufacturer's instructions.
- C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
- D. Apply mastic to seal penetrations, small cracks, or minor honeycomb in substrate.

3.03 APPLICATION

- A. Interior Vertical Surfaces of Planter Walls:
 1. Apply long fiber fibrated material in 1 coat by trowel.
 2. Fill in crevices and grooves, providing continuous coating and free from breaks and pinholes. Carry coating over exposed top and outside edge of footing. Spread around joints, grooves and slots, and into chases, corners, reveals and soffits. Bring coating to finished grade.
 3. Install protection board directly to tacky surface of damp-proofing membrane.
 4. Place backfill at least 24 to 48 hours after application, but within 7 days.

3.04 PROTECTION

- A. Protect application from damage during construction.

END OF SECTION

SECTION 07 21 00 – CONTINUOUS THERMAL INSULATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes fire-resistant, rigid board insulation consisting of a polyisocyanurate foam core laminated to aluminum foil facers installed at the following locations:
 - 1. Masonry cavity wall construction
 - 2. Behind metal wall panels.
- B. Related Sections:
 - 1. Section 04 20 19 – Veneer Unit Masonry: Board insulation installed in cavity wall.
 - a. Coordinate with masonry veneer anchors.
 - 2. Section 04 43 13 – Mortar-Placed Stone Veneer: Board insulation installed in cavity wall.
 - a. Coordinate with stone veneer anchors.
 - 3. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Board insulation installed over air barrier.
 - a. Board insulation and adhesive shall be compatible with the air barrier system.
 - b. Board insulation shall have been tested and passed NFPA 285 fire test with the specified fluid-applied membrane air barriers specified in Section 07 27 26.
 - 4. Section 07 40 00 – Cladding-Support-System: Metal Z furring and J track with thermal tape for use with board insulation specified in this Section behind:
 - a. Metal wall panels.
 - 5. Section 07 42 13-Metal Wall and Soffit Panels.
 - a. Installing board insulation between metal zee furring for metal wall panels.

1.02 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM C203 - Test Method for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
 - 2. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 3. ASTM 1289 - Standard Specification for Faced Rigid Cellular Cellular Polyisocy-

anurate Thermal Insulation.

4. ASTM D1621 - Test Method for Compressive Properties of Rigid Cellular Plastics.
 5. ASTM D1622 - Test Method for Apparent Density of Rigid Cellular Plastics.
 6. ASTM D2126 - Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
 7. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 8. ASTM E96/E96M - Test Method for Water Vapor Transmission of Materials.
- B. National Fire Protection Agency:
1. NFPA 285-12 for the 2015 IBC: Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Construction.

1.03 SYSTEM DESCRIPTION

- A. Materials of This Section: Provide thermal protection to air and seal materials at building enclosure elements in conjunction with air barrier materials in Section 07 27 26.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures
- B. Product Data: Submit data on product characteristics, performance criteria, limitations and adhesives.
- C. Submit documentation that the board insulation has been tested and passed NFPA 285 wall assembly using air barrier membranes specified in Section 07 27 26.
- D. Submit Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product verifying qualities of insulation components meet or exceed specified requirements.
- E. Submit Field Inspection and Field-Testing Reports in accordance with Field Quality Control requirements.
- F. Manufacturers printed installation instructions for each type of material to be used.
1. Certify adhesive used to bond insulation to air barrier membrane is compatible with specified air barrier membrane.
- G. Submit Material Safety Data Sheets (MSDS) for each type of insulation to be used.
- H. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES
- I. Provide written certification from the manufacturer of the board insulation stating that the

board insulation is compatible with the fluid applied membrane air barrier system specified in Section 07 27 26.

- J. Warranty: Provide manufacturer's minimum 15-year thermal performance warranty.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements.
- B. Do not install adhesives when temperature or weather conditions are detrimental to successful installation.

1.06 SEQUENCING

- A. Sequence Work to ensure air barrier materials are in place before beginning work of this section.

1.07 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with Section 07 27 26 for air barrier materials. Board adhesive shall be compatible with air barrier materials.

1.08 QUALITY ASSURANCE

- A. Source Limitations: Provide each type of building insulation and related accessories from one single manufacturer.
- B. Installer Qualifications:
 - 1. Contractor shall provide evidence of having completed 3 projects of similar size and scope in the past 3 years.
 - 2. Contractor shall provide evidence of certification by the rigid insulation manufacturer as having been properly trained in the proper installation of the submitted products.
- C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- D. Assembly Fire Propagation Characteristics: Provide results of tests performed on wall assemblies tested by manufacturer in accordance with NFPA 285.

1.09 PRE-INSTALLATION MEETING

- A. Prior to start of insulation installation review and document insulation installation methods and procedures including:
 - 1. Participants
 - 2. Substrate conditions

3. Manufacturer's installation guidelines
4. Construction schedule
5. Governing regulatory requirements and requirements for insurance
6. Review field quality control procedures

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect foam-plastic board insulation as follows:
 1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
 2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project Site before installation time.
 3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

1.11 WARRANTY

- A. Minimum warranty period is 15 years from the date insulation is installed.

PART 2 PRODUCTS

1.01 MATERIALS

- A. **Foil-Faced, Polyisocyanurate Board Insulation per ASTM C1289:** Type 1 - Faced with aluminum foil on both major surfaces of the core, Class 1- non-reinforced core foam or Class 2 – glass-fiber reinforced core foam, Grade 3 - 25 psi.
- B. Foam Surface Burning Characteristics per ASTM E84:
 1. Maximum flame spread: Equal to or less than 25.
 2. Maximum smoke-developed index: Equal to or less than 450.
- C. Compressive Strength per ASTM C1621: Minimum 25 psi.
- D. Flexural Strength per ASTM C203: Equal to or greater than 40 psi.
- E. Water Vapor Transmission per ASTM E96: Equal to or less than 0.03 perms per inch.
- F. Water Absorption per ASTM C209: Maximum $\leq 1\%$ by volume.
- G. Density per ASTM D1622: 2.0 pcf.
- H. Thermal Resistance per ASTM C518: R-value per thickness:

1. 2.0 inches: R-13.
 - I. Faces: 12 mil thick aluminum foil facer, both sides.
 - J. Board Thickness:
 1. 2 inches.
 - K. Board Size: 48 inches by 120 inches. NOTE: Board shall be scored on both sides to fit between spacing of masonry anchors.
 - L. Board edges: Square.
 - M. Acceptable Manufacturer's and Products: Subject to compliance with requirements of Contract Documents, provide products by one of manufacturer's named below. If not named, submit as a substitution according to Conditions of the Contract and appropriate Division 01 Sections.
 1. Atlas: EnergyShield Pro.
 - a. In accordance with NFPA 285, the following fluid-applied membrane air barriers as specified in Section 07 27 26 are approved for use in conjunction with the above referenced board insulation as part of the wall system.
 - 1) Kemper Systems America, Inc.: FW 100A.
 - 2) W.R. Meadows: Air-Shield LMP (Gray)
 2. Hunter: Xci Foil (Class A).
 - a. In accordance with NFPA 285, the following fluid-applied membrane air barrier as specified in Section 07 27 26 are approved for use in conjunction with the above referenced board insulation as part of the wall system.
 - 1) Kemper Systems America, Inc: FW100A.
 - 2) W.R. Meadows: Air-Shield LMP (Gray).
 3. Rmax: ECOMAXci FR.
 - a. In accordance with NFPA 285, the following fluid-applied membrane air barriers as specified in Section 07 27 26 are approved for use in conjunction with the above referenced board insulation as part of the wall system.
 - 1) Sika: Sikagard 535.
 - 2) W.R. Meadows: Air-Shield LMP (Gray).
 - N. Recycled Content: Pre-consumer recycled content not less than 3.4%

1.02 ACCESSORIES

- A. Sealant/Adhesive for Bonding Insulation to specified air barrier membrane:
 - 1. Sealant/adhesive with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates and as recommended by insulation manufacturer.
 - a. Adhesive used to bond insulation to air barrier membrane shall be compatible with specified air barrier membrane in Section 07 27 26.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clean substrates of substances that are harmful to insulation including removing projections capable of puncturing foil facer, or that interfere with insulation attachment.
- B. Ensure products are dry prior to installation. Replace damaged products.

3.02 INSTALLATION, GENERAL

- A. Install insulation with the long edge vertical behind unit masonry veneer and horizontal behind mortar placed stone veneer and metal wall panels, printed side to the exterior.
- B. Install in as large of pieces as possible to minimize joints.
- C. Abut wall insulation tightly together both horizontally and vertically, and at all openings.
- D. Comply with insulation manufacturer's written installation instructions.
- E. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- F. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- G. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths.
- H. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
 - 1. Stagger successive layers a minimum of 16" both vertically and horizontally so joints in successive layers do not align.

3.03 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Adhesive Installation:
 - 1. Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face, and as recommended by adhesive manufacturer.

2. Fit courses of insulation between wall ties, metal zee furring and other obstructions, with edges butted tightly in both directions. Press units firmly against inside substrates.

3.04 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- B. Do not leave continuous insulation uncovered and exposed to UV for longer than an aggregate of 60 days between storage and uncovered installation.
- C. At the end of each work day seal exposed edges to be weathertight.

3.05 PROJECT CLEAN UP

- A. Removal all packaging and properly recycle.
- B. Remove all scrap materials and properly dispose of offsite.

END OF SECTION

SECTION 07 21 16 – BLANKET INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Thermal Batt Insulation.
- B. Stone Wool Batt Insulation.

1.02 RELATED SECTIONS

- A. Section 05 40 00 – Cold Formed Metal Framing: Installing thermal batt insulation between metal studs.
- B. Section 07 72 10 – Roof Curbs: Installing stone wool batt insulation within roof curb framing.
- C. Section 09 21 16 – Gypsum Board Assemblies: Acoustic insulation.
- D. Section 09 22 16 – Non-Structural Metal Framing: Installing acoustic insulation and thermal batt insulation between metal studs.
- E. Division 23: Installing stone wool batt insulation within rooftop mechanical curbs.

1.03 REFERENCES

- A. American Society for Testing Materials:
 - 1. ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - 2. ASTM C665 – Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 3. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
 - 5. ASTM E136 – Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
 - 6. ASTM E970 – Standard Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project location.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS – THERMAL AND ACOUSTICAL INSULATION MATERIALS

- A. Certainteed Corporation
 - 1. Unfaced sustainable insulation CertaPro AcoustaTherm Batts.
- B. Johns Manville
 - 1. Unfaced formaldehyde-free batt insulation
- C. Owens Corning
 - 1. EcoTouch Pink Fiberglas Insulation
- D. Rockwool Inc.
 - 1. Comfortbatt (Stone wool)
- E. Substitutions per Section 01 60 00.

2.02 MATERIALS

- A. Thermal Batt Insulation: ASTM C665; pre-formed glass fiber or glass mineral wool batt; friction fit, between metal studs, conforming to the following:
 - 1. Thermal Resistance:
 - a. Exterior Walls:
 - 1) At 6- inch metal studs install R19.
 - 2) At 3-5/8 and 2 ½ inch metal stud walls install R13.
 - b. Facing: Unfaced.
 - c. Flame/Smoke Properties: 25/450 in accordance with ASTM E84.
 - d. Material shall be formaldehyde free.
- B. Stone wool batt insulation: Non-combustible, lightweight, water repellent, semi-rigid wool batt insulation, ASTM C665, Type 1
 - 1. Thermal Resistance:
 - a. Exterior Walls:
 - 1) At 6 inch metal studs install 6 inch, R24 insulation.

- 2) At 3-5/8 inch metal stud walls install 3 ½ inch, R15 insulation.
 - 3) At 2 ½ inch metal stud walls install 2 1/2" inch, R10 insulation.
- b. Curbs:
- 1) At equipment curbs install 3 ½ inch, R15 insulation.
 - 2) At rooftop mechanical curbs install 6 inch, R24 insulation.
- c. Acceptable material: Rockwool Inc., Comfortbatt, 16 inch by 48 inch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.02 INSTALLATION

- A. Install insulation in accordance with insulation manufacturer's instructions.
- B. Install thermal batts in exterior walls as shown on the Drawings without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.
- E. Install rock mineral wool insulation between exterior metal stud framing where the insulation will be exposed to the elements before the exterior wall sheathing can be applied and sealed and at other locations noted.
- F. At built-up metal stud headers installed at exterior walls, fill header with stone wool batt insulation using 6 inch R24 insulation.
- G. At built up jamb studs fill cavity with stone wool batt insulation.
- H. At roof curbs install 3 ½ inch R 15 stone wool batt insulation.
- I. At rooftop mechanical curbs install 6 inch R24 stone wool batt insulation.

END OF SECTION

SECTION 07 26 13 – MOISTURE CONTROL SYSTEM

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the furnishing and application of moisture control systems and self-leveling underlayment for the reduction of moisture vapor transmission and alkalinity control for interior concrete slabs requiring the installation of following materials:

1. Resilient Tile Flooring.
2. Carpet.
3. Ceramic floor tile: Water proofing membrane, crack isolation membranes.

1.02 RELATED SECTIONS

- A. Section 01 20 00 – Prices and Payment Procedures: Unit price for performing Work specified in this Section.
- B. Section 01 40 00 – Quality Requirements.
- C. Section 01 45 23 – Concrete In-Situ Relative Humidity and pH Testing: Testing requirements.
- D. Section 03 30 00 – Cast-In-Place Concrete: Installation and curing requirements.
- E. Section 09 30 00-Tile: Installation of water proofing membranes and/or crack isolation membranes.
- F. Section 09 65 00 – Resilient Flooring: Resilient flooring installation requirements.
- G. Section 09 68 13 – Tile Carpeting: Carpet installation requirements.
- H. Section 12 48 13 – Entrance Floor Mats and Frames.

1.03 REFERENCES

- A. American Society of Testing Materials:
1. ASTM D7234 – Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
 2. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
 3. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.
 4. ASTM F3010 – Standard Practice for Two-Component Resin Based Membrane Flooring Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

- B. ICRI, International Concrete Repair Institute.

1.04 TESTING

- A. Before installation of the finish floor materials over the concrete slabs, in-situ relative humidity testing per ASTM F2170 and pH testing shall be performed by the Owner's Testing Lab to determine the level of water vapor transmission in the slab and the type of moisture reduction system required. Refer to Section 01 45 23 for testing procedures.
- B. The Owner's Testing Lab shall coordinate the test with the General Contractor's project scheduling to allow sufficient time to test, submit their findings and install the moisture control system before the installation of the finish flooring materials.

1.05 SUBMITTALS

- A. General: Submit in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide product data for each type of product and process specified which shall include the following:
 - 1. Manufacturer's specifications.
 - 2. Manufacturer's installation instructions.
 - 3. Independent test data.
 - 4. Certification requirements.
 - 5. Warranty information.
- C. The installer of the moisture control system shall submit the following tests obtained from the General Contractor:
 - 1. Test results from the in-situ relative humidity testing according to ASTM F2170.
 - 2. Test results from the pH test.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installation of the Moisture Control System shall be by a manufacturer-approved installer with experience in surface preparation and application of the materials specified.
 - 2. Approved installer shall have not less than five (5) years of experience installing the moisture control system specified.
- B. Manufacturer's Qualifications:
 - 1. The manufacturer shall have not less than three (3) years of experience in manufacturing the same moisture control system. The moisture control system shall be specifically formulated and marketed internationally for moisture control

and alkalinity control without change of formulation or system design for a minimum period of three (3) years.

2. Manufacturer shall provide the Owner with their standard 15-year warranty at no additional cost.
3. Manufacturer shall provide Independent lab test reports documenting performance per the following:
 - a. ASTM E96 – Water Vapor Transmission (dry and wet methods). Performance shall be documented at a minimum 90 percent water vapor transmission reduction compared to untreated durable concrete.
- C. The Moisture Control System shall be installed only over concrete surfaces that have been properly mechanically prepared to a minimum surface profile of ICRI CSP #3 and which have an RH value of 100 percent or less when measured in accordance with ASTM F2170.
- D. The moisture control system shall comply with ASTM F3010 – Standard Practice for Two-Component Resin Based Membrane Flooring Moisture Mitigation Systems for Use Under Resilient Floor Coverings.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to the job site in their original unopened containers, clearly labeled with the manufacturer's name and brand designation.
- B. Store products in an approved ventilated dry area, protect from moisture, freezing and direct sunlight.

1.08 WARRANTY

- A. Manufacturer's Warranty: Warrant vapor emission control treatment against manufacturing defects and improper installations for a period of 15 years.
 1. Cover costs of treatment materials, cementitious compounds and labor costs of application and preparation.
 2. Extend warranty to flooring material, adhesive and installation labor for same period against moisture vapor emission and alkalinity-related failure.
 3. Provide warranty underwritten by product liability insurance carrier having a minimum "A" rating from Best or equivalent rating system in the amount of \$5,000,000 per occurrence and naming Owner, Architect and Contractor as co-insured.
 4. Warranty may not exclude concrete slabs containing silica or silicate compounds.

1.09 SITE CONDITIONS

- A. Do not apply moisture control system to unprotected surfaces or surfaces with standing water.
- B. Do not apply moisture control system below 50 degrees F surface temperature or where

the temperature is expected to fall below 50 degrees F within 24 hours from time of application.

- C. Allow for continuous ventilation and indirect air movement at all times during application and curing process.

PART 2 PRODUCTS

2.01 MANUFACTURERS/PRODUCTS

- A. Moisture control systems which may be incorporated in the Work shall be the product of a single manufacturer:

1. Manufacturer: Allied Construction Technologies, Inc.

a. Products

- 1) Moisture control system: AC Tech 2170, two component, fluid applied 100 solids epoxy based moisture control system.
 - a) VOC content: 0 g/L < 100 g/L.
- 2) Underlayment primer: AC Tech 2170 SLP self-leveling primer.
 - a) VOC content: 0 g/L < 100 g/L.
- 3) Portland-cement-based underlayment system: Self-leveling underlayment concrete system recommended by AC Tech.
 - a) VOC content: 0 g/L < 100 g/L.

2. Manufacturer: Ardex Engineered Cements

a. Products

- 1) Moisture control system: Ardex MC Plus, two-coat moisture control system consisting of a primer and sealer.
 - b) VOC content: 0 g/L < 100 g/L.
- 2) Underlayment primer: Ardex P82 Ultra primer.
 - c) VOC content: 0 g/L < 100 g/L.
- 3) Portland-cement-based underlayment system: Ardex K15 Premium self-leveling underlayment concrete.
 - d) VOC content: 0 g/L < 100 g/L.

3. Manufacturer: Koster American Corporation.

a. Products:

- 1) Moisture control system: Koster VAP 1 2000 Zero (Zero VOC's) System.
 - a) VOC content: 0 g/L < 100 g/L.
 - 2) Underlayment primer: VAP 1 06 primer.
 - a) VOC content: 0 g/L < 100 g/L.
 - 3) Portland-cement-based underlayment system: Koster SL Standard or SL Premium self-leveling underlayment.
 - a) VOC content: 0 g/L < 100 g/L.
- B. Materials: Provide all required materials necessary for a complete installation over the concrete surface where the vapor emissions, the relative humidity and pH levels of the concrete are in conformance with the flooring manufacturer's requirements and the concrete surface is suitable to receive the finish floor materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Pre-Installation Moisture Testing: Conduct pre-installation concrete relative humidity and alkalinity testing on all interior slab areas to receive finish flooring.
- B. Examine concrete substrates with Installer present for compliance with requirements for installation of concrete moisture-vapor and alkalinity control system. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Inspect all surfaces with regard to their suitability to receive the moisture control system with the manufacturer's representative.
- B. The concrete shall be clean, and free of all oil, grease, dirt, curing compounds and any substance that might act as a bond breaker.
 1. Verify surfaces to be treated with the moisture control system have not been previously treated with other materials such as underlayments, screeds or penetrating sealers. Notify manufacturer's representative of these conditions prior to application of the moisture control system.
- C. Shotblast all floors to a concrete surface profile of #3 or #4 and clean surfaces to remove all residue off the concrete. Fibers used to reinforce the concrete shall be burned off, scraped and vacuumed. Remove all fibers, after shotblasting, leaving no fibers on the concrete surface. Acid etching and the use of sweeping compounds and solvents are not permitted as means of preparing the substrate.
 1. Shotblast a small area and verify with the specific floor applicator that the surfaces are fit to receive the specified flooring system without application of an underlayment.

- D. Repair concrete prior to moisture vapor reduction system installation using materials recommended by moisture system control manufacturer.
- E. Joint and Crack Preparation:
 - 1. Moving Joints: Do not bridge moving joints with the moisture control system.
 - 2. Saw Cuts, Control Joints and Non-Moving Cracks: Fill all non-moving joints and cracks with material recommended by manufacturer of the moisture control system.

3.03 APPLICATION

- A. Mix and apply moisture control system following the printed instructions from the manufacturer.
- B. Apply self-leveling cementitious underlayment and primer to a smooth and level surface, after installation of the moisture control system. Install to a thickness of minimum 1/8 inch.

3.04 PROTECTION

- A. Protect each coat during the required cure time from any kind of traffic, water and contaminants.

END OF SECTION

SECTION 07 26 16 – UNDER-SLAB VAPOR BARRIER

PART 1 GENERAL

1.01 SUMMARY

A. Products Supplied Under This Section:

1. Vapor barrier, seam tape, mastic, pipe boots, detail strip for installation under concrete slabs.

B. Related Sections:

1. Section 03 30 00 – Cast-in-Place Structural Concrete.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM D1709: Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart.
2. ASTM E96: Standard Test Methods for Water Vapor Transmission of Materials.
3. ASTM E154: Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs on Walls or as Ground Cover.
4. ASTM E1643: Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
5. ASTM E1745: Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
6. ASTM F1249: Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.

B. American Concrete Institute (ACI)

1. ACI 302.2R-06: Guide for Concrete Slabs that Receive Moisture-Sensitive Materials.
 - a. Vapor barriers not protected by fill shall be 15 mils or thicker.
 - b. Vapor barriers shall have a perm rating **BELOW** 0.01 US perms (grains/ft² * hr * in. Hg) or less.

1.03 SUBMITTALS

A. Quality Assurance:

1. Independent laboratory test results showing compliance with ASTM E1745 Class A and Perm rating of 0.01 grains/ft² * hr * in. Hg or less, per ASTM E96 or ASTM F1249. The water vapor permeance shall only be expressed in the perm unit

grains/ft² * hr * in. Hg.

2. Independent laboratory test results showing compliance with ASTM E154, maintaining permeance of less than 0.01 perms (grains/ft² * hr * in. Hg) after mandatory conditioning test per sections 8, 11, 12 and 13 of ASTM E154.
 3. Manufacturer's samples, literature.
 4. Manufacturer's installation instructions for placement, seaming and pipe boot installation.
- B. Pre-Installation Conference:
1. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
 2. Convene minimum four weeks prior to commencing work of this section at the project site. Participants include Contractor, concrete subcontractor and under-slab vapor barrier manufacturer. Advise the Architect of the scheduled meeting date.

PART 2 PRODUCTS

2.01 MATERIALS

A. Vapor Barrier:

1. Vapor Barrier membrane must have the following properties:
 - a. Manufactured from prime virgin resins
Products made from the following materials are not acceptable:
 - 1) Woven products.
 - 2) Recycled plastics.
 - 3) Laminated materials
 - b. Water Vapor Barrier: ASTM E1745; meets or exceeds Class A.
 - c. Water Vapor Permeance Rating: ASTM E96 or ASTM F1249: Less than 0.01 US perms (grains/ft² * hr * in. Hg).
 - 1) Maintain permeance of less than 0.01 perms (grains/ft² * hr * in. Hg) after mandatory conditioning tests per ASTM E154, Sections 8, 11, 12 and 13.
 - d. Thickness: 15 mil.
 - e. Puncture Resistance: 2326 grams.
 - f. Basis of Design: Contract Documents are based on manufacturer and products named below. Other acceptable manufacturer's with products having equivalent characteristics may be provided.
 - 1) Basis of Design: Stego Wrap 15-mil vapor barrier by Stego Industries.
 - 2) Acceptable Manufacturer's and Products:

- i. Fortifiber Building Systems Group, Moistop Ultra 15.
- ii. W.R. Meadows, Perminator.

- 3) Substitutions: Permitted in accordance with the Contract Documents.

2.02 ACCESSORIES

A. Seams

- 1. Tape by Stego Industries. Tape shall have the following qualities:
 - a. A 3 ¾ inches wide tape composed of polyethylene film and an acrylic, pressure-sensitive adhesive.
 - b. Water Vapor Transmission Rate: ASTM E96; 0.3 perms or lower.

B. Sealing penetrations in the vapor barrier

- 1. Use one or both of the following materials:
 - a. Stego Mastic by Stego Industries.
 - 1) Mastic must have the following qualities:
 - 2) Water Vapor Transmission Rate: ASTM E96; 0.3 perms or lower.
 - b. Stego Tape by Stego Industries.

C. Perimeter/edge seal

- 1. StegoTack Tape by Stego Industries: A 2-inch-wide double-sided adhesive strip.

D. Pre-Cut Pipe Boots

- 1. Stego Pre-Cut Pipe Boots, constructed from vapor barrier material, pressure sensitive tape and/or mastic per manufacturer's instructions.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ensure that subsoil is approved by Architect or geotechnical firm.
- B. Level and tamp or roll aggregate, sand or tamped earth base.

3.02 INSTALLATION

A. Install Vapor Barrier:

- 1. Installation shall be in accordance with manufacturer's instructions and ASTM E1643.
 - a. Unroll Vapor Barrier with the longest dimension parallel with the direction of the pour.

- 1) Face laps away from direction of placement of concrete.
- b. Overlap joints 6 inches and seal laps using the following tape:
 - 1) At slab-on-grade seal joints using Stego 3 ¾ inch wide seam tape.
- c. Seal vapor barrier to perimeter of slab using Stego 2-inch-wide double-sided tape.
- d. Seal all penetrations (including pipes) per manufacturer's instructions.
- e. No penetration of the Vapor Barrier is allowed except for reinforcing steel and permanent utilities.
- f. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

END OF SECTION

SECTION 07 27 26 – FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Materials and installation methods supplementing a one-component vapor permeable, liquid applied, elastic air, and water barrier.
- B. Materials and installation to bridge and seal the following air leakage pathways and gaps:
 - 1. Connections of the walls to the roof air barrier.
 - 2. Connections of the walls to the foundations.
 - 3. Expansion joints.
 - 4. Openings and penetrations of storefront.
 - 5. Door frames.
 - 6. Piping, conduit, duct and similar penetrations.
 - 7. Masonry ties, screws, bolts and similar penetrations.
 - 8. All other air leakage pathways in the building envelope.

1.02 RELATED SECTIONS

- A. Section 04 20 00 – Unit Masonry: Sealing masonry ties to air barrier membrane.
- B. Section 04 20 19 – Veneer Unit Masonry: Sealing masonry ties to air barrier membrane.
- C. Section 04 43 13- Mortar-Placed Stone Veneer: Sealing masonry ties to air barrier membrane.
- D. Section 06 10 53 – Miscellaneous Carpentry: Covering preservative-treated materials with self-adhering membranes.
- E. Section 06 16 43 – Gypsum Sheathing: Installing air barrier membrane over glass-faced gypsum sheathing and roof board.
- F. Section 07 21 00 – Continuous Thermal Insulation: Compliance with NFPA 285 Fire Test with insulation products.
- G. Section 07 40 00 – Cladding Support System: Securing metal Z tracks and J tracks to air barrier membrane.
- H. Section 07 54 23-Thermoplastic Polyolefin Roofing. Attaching air barrier membrane tape and fluid applied membrane to TPO roof membrane.

1. Verify compatibility of materials specified in this section with TPO roofing membrane.
- I. Section 07 62 00 – Sheet Metal Flashing and Trim: Coordination of TPO base flashing with at copings with air barrier membrane.
 1. Verify compatibility of TPO base flashing with air barrier membrane.
- J. Section 07 65 10 – Flexible Flashing: Coordination of flexible flashing with fluid-applied membrane air barriers.
- K. Section 07 90 00-Joint Protection: Sealants in contact with fluid-applied membrane air barrier system shall be compatible with system.

1.03 REFERENCES

- A. American Association of Textile Chemists and Colorists:
 1. AATCC 127-03 – Water Resistance: Hydrostatic Pressure Test.
- B. Air Barrier Association of America.
- C. ASTM:
 1. ASTM C1305 – Standard Test Method for Crack Bridging Ability of Liquid-Applied Waterproofing Membrane.
 2. ASTM D1970-01 – Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 3. ASTM D4541-05 – Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 4. ASTM D4586 – Standard Specification for Asphalt Roof Cement, Asbestos Free.
 5. ASTM E2178-03: Standard Test for Determining the Air Permeability of Building Materials.
 6. ASTM E2357-05: Standard Test Method for Determining Air Leakage of Air Barrier Assemblies. **NOTE: TESTS SHALL BE CONDUCTED ON STEEL STUD FRAME WALLS.**
 7. ASTM E96-00e1: Standard Test Methods for Water Vapor Transmission of Materials.
- D. International Energy Conservation Code
 1. IECC 2015, Chapter 4, Commercial Energy Efficiency, Section C402.5 Air Leakage - Thermal Envelope (mandatory):
 - a. A continuous air barrier shall be provided in all climate zones except 2B.

- E. International Code Council – Evaluation Service:
 - 1. ICC-ES-AC212 – Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers Over Sheathing.
- F. National Fire Protection Agency
 - 1. NFPA 285-12 for 2015 IBC: Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Construction.

1.04 PERFORMANCE REQUIREMENTS

- A. Provide an air barrier system constructed to perform as a continuous elastic air barrier, and as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Membrane shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.
 - 1. The air barrier shall have the following characteristics:
 - a. It must be continuous, with all joints made air-tight.
 - b. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load. The air barrier shall be joined in an airtight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
 - 1) Foundation and walls.
 - 2) Walls and windows or doors.
 - 3) Different wall systems.
 - 4) Wall and roof.
 - 5) Wall and roof over unconditioned space.
 - 6) Walls, floor and roof across construction, control and expansion joints.
 - 7) Walls, floors and roof to utility, pipe and duct penetrations.
 - 8) Flashing to wall surface.
 - 2. All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight.
- B. Accredited Laboratory:
 - 1. The testing laboratory shall be accredited to perform the test protocol for each test method listed in Article 1.04 of this section.
 - 2. The accreditation organizations for laboratories shall be one of the following:
 - a. IAS (International Accreditation Service, Inc.)
 - b. A2LA (American Association for Laboratory Accreditation)
 - c. SCC (Standard Council of Canada)

C. Testing Methods:

1. All testing performed in accordance with all the test methods listed shall be conducted with the liquid-applied material within the minimum/maximum range listed. The specific thickness of the liquid-applied material which was used when conducting the following tests shall be recorded on the test report and shall be the site-installed thickness.
2. Air Leakage:
 - a. Assemblies of materials and components shall have an air leakage not to exceed 0.04 cfm/ft² under a pressure differential of 0.3 in. water (1.57 psf) (0.2 L/s•m² @ 75 Pa) when tested in accordance with ASTM E2357-05 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.
 - 1) This procedure measures the air leakage of representative air barrier assembly before and after exposure to specific conditioning cycles and then assigns a rating dependent upon the results.
 - 2) The results will include the air permeance of the material (the amount of air that passes through the material) the air permeance of the components (the amount of air that passes through the material) and the air leakage that results from joining all the pieces together.
 - b. Test specimens: Test shall be performed on three specimens constructed of frame construction.
 - 1) Specimen 1: Opaque wall min. size 2400 mm (7.87 feet) by 2400 mm (7.87 feet) per ASTM E2357, Annex A1, Figure A1.1.
 - 2) Specimen 2: Penetrations, terminations and connections per ASTM E2357, Annex A1, Figure A1.2.
 - 3) Specimen 3: Roof/foundation interface and opaque wall. Size 2400 mm (7.87 feet) x 2500 mm (8.20 feet) with 300 mm (.98 feet) high concrete beam, per ASTM E2357 Annex A1, Figure A1.3.
 - c. After the initial leakage testing the specimens shall be exposed to the following loads:
 - 1) Sustained positive and negative load of 600 Pa (12.53 psf) for one hour
 - 2) Cyclic positive and negative load of 800 Pa (16.70 psf) for 3 seconds for 2,000 cycles with positive load and 2,000 cycles with negative load
 - 3) Gust wind load positive and negative for 3 seconds at 1,200 Pa (25.06 psf)
 - 4) Refer to ASTM E2357 Annex A3, Figure A3.1 Structural (Wind) Loading Schedule.
 - d. The maximum deflection of the air barrier material shall be recorded at the following wind pressure loading: $D_{0.60}$ @ 1440 Pa (30.08 psf). The

wind loading pressure shall be maintained for a period of 10 seconds and the maximum deflection at any point on the specimens, from the supporting member of the air barrier assembly shall be determined for both positive and negative pressures.

3. Air Permeance of Materials:
 - a. Materials used for the air barrier system in the opaque envelope shall have an air permeance not to exceed 0.004 cfm/ft² under a pressure differential of 0.3 in. water (1.57 psf) (0.02 L/s.m² @ 75 Pa) when tested in accordance with ASTM E2178-03.
 4. Water vapor transmission of the liquid membrane
 - a. Declare the water vapor permeance (water and desiccant method) at the applied thickness in accordance with ASTM E96-00e1.
 5. Water resistance of the liquid membrane
 - a. The water resistance of the liquid membrane when tested in accordance with AATCC 127-03 at a hydrostatic pressure test for five hours shall be a minimum of 55 cm.
 6. Fastener sealability of the liquid membrane
 - a. The sealability of the liquid membrane in accordance with ASTM D1970-01, Section 7.9 Nail Sealability, shall have passed the test.
 7. Pull adhesion of the liquid membrane
 - a. The minimum requirement for the pull adhesion of the liquid membrane in accordance with ASTM D4541-05 shall be 100 kPa or report force at substrate failure. Specify substrates or surface preparation for glass-faced gypsum sheathing and concrete block.
 8. Crack bridging of the liquid membrane
 - a. The liquid membrane when tested in accordance with ICC ES-AC212 or ASTM C1305 shall have passed either test method.
- D. Fire Testing:
1. The air barrier as a component of a wall assembly which includes foam plastic insulation shall have been tested and passed NFPA 285.

1.05 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data, installation instructions, and manufacturer's printed instructions for evaluating, preparing and treating substrate, temperature and other limitations of installation conditions, technical data, and tested

physical and performance properties.

1. Submit data on all products used in the wall assembly tested in accordance with ASTM E2357, Specimen 2.
 - a. Provide data on how all penetrations in the membrane of the test specimen were sealed including materials used to seal the penetrations which include pipe and duct penetrations, masonry tie fasteners, window openings, junction boxes, joints in the sheathing and concrete block.
 2. Provide data on specific thickness of materials tested per Article 1.04.
 3. Submit letter from primary materials manufacturer indicating approval of products not manufactured by primary manufacturer.
 4. Include statement that materials are compatible with adjacent materials proposed for use.
 5. Submit reports indicating that field peel-adhesion test on all materials to which sealants are adhered have been performed and the changes made, if required, to other approved materials, in order to achieve successful adhesion.
- C. Prior to commencing work, provide test data from an approved independent testing laboratory certifying the air leakage rates of the air barrier assembly, including primary membrane, primer and sealants have been tested to meet ASTM E2357 on a framed wall and the air leakage requirements identified in Article 1.04.
1. Provide data on all materials used to construct each specimen wall.
 2. Provide copies of the report per ASTM E2357, 11.
- D. Prior to commencing work, provide documentation from an approved independent testing laboratory certifying the air leakage rates of the air barrier membrane, including transition membranes in accordance with ASTM E2178 and the air permeance requirements identified in Article 1.04.
- E. Prior to commencing work, the air barrier manufacturer shall submit all other test reports identified in Article 1.04 of this section.
- F. Prior to commencing work, submit documentation that the air barrier membrane has been tested and passed NFPA 285 wall assembly using the board insulation products specified in Section 07 21 00.
- G. Prior to commencing the Work, submit references clearly indicating that the materials proposed have been installed for not less than three years on projects of similar scope and nature. Submit references for a minimum of five projects.
- H. Shop Drawings: Prior to commencing the Work, submit project specific Shop Drawings showing locations and extent of air and vapor barrier assemblies and details of all typical conditions, intersections with other envelope assemblies and materials, membrane counterflashings, and details showing how gaps in the construction will be bridged, how inside and outside corners are negotiated, how materials that cover the air and vapor barrier are secured with airtight condition maintained, and how miscellaneous penetrations such as conduits, pipes, electric boxes and similar items are sealed. The

manufacturer's representative shall review the Contract Drawings and note any modifications required to make the system air and water tight.

- I. Certification of compatibility by air barrier manufacturer, listing all materials on the project that it connects to or that come in contact with it.

1.06 QUALITY ASSURANCE

- A. Air barrier assemblies shall be evaluated both as a material in accordance with ASTM E2178 and as an assembly in accordance with ASTM E2357 by the Air Barrier Association of America as well as passed all other evaluations by the Air Barrier Association of America.
- B. The air barrier assembly shall have been tested and passed NFPA 285 Fire Test as part of the tested wall assembly which included closed-cell polyisocyanurate foam laminated to foil facers.
- C. Manufacturer's Qualifications: Provide primary products, including each component of the air barrier membrane system, which has been commercially available for a minimum of 3 years.
- D. Submit in writing, a document stating that the applicator of the primary air barrier membrane specified in this section is recognized by the manufacturer as suitable for the execution of the Work.
- E. Perform Work in accordance with the printed requirements of the air barrier manufacturer and this specification.
- F. Maintain one copy of manufacturer instructions on site.
- G. At the beginning of the Work and at all times during the execution of the Work, allow access to Work site by the air barrier membrane manufacturer's representative.
- H. Components used in this section shall be sourced from one manufacturer, including sheet membrane, air barrier sealants, primers, mastics and adhesives.

1.07 MOCK-UP

- A. Construct mock-up in accordance with Section 01 40 00 – Quality Requirements: Requirements for a mock-up.
- B. Provide mock-up of air barrier materials under provisions of Section 04 20 19 – Veneer Unit Masonry.
- C. Provide mock-up of air barrier materials under provisions of Section 04 43 13 – Mortar-Placed Stone Veneer.
- D. Items to be incorporated in mock-up include:
 1. Where directed by Architect, construct typical exterior wall panel, size as indicated on drawings, incorporating masonry veneer system, through wall flexible flashing, glass-faced gypsum sheathing, wall ties, board insulation, metal

studs, aluminum storefront frame, showing air barrier membrane application details and transition membranes.

2. Where directed by Architect, construct typical exterior wall panel, size as indicated on drawings, incorporating metal wall panels, metal furring per Section 07 40 00, board insulation, metal stud framing, glass faced gypsum sheathing, aluminum storefront frame, showing air barrier membrane application details and transition membranes.

1.08 PRE-INSTALLATION CONFERENCE

- A. Convene four weeks prior to commencing work of this section, under provisions of Section 01 30 00 – Administrative Requirements: Pre-installation meeting. Attendance by the manufacturer's representative along with the installer is **mandatory**.

DO NOT PROCEED WITH THE INSTALLATION OF THE AIR BARRIER MEMBRANE AND THE THROUGH WALL FLASHING MEMBRANE PRIOR TO THE PRE-INSTALLATION CONFERENCE.

DO NOT PROCEED WITH THE PRE-INSTALLATION CONFERENCE IF ANY ONE OF THE FOLLOWING PARTIES IS NOT IN ATTENDANCE:

**MANUFACTURER'S REPRESENTATIVE
INSTALLER
OWNER'S REPRESENTATIVE (IF APPLICABLE)
ARCHITECT
GENERAL CONTRACTOR**

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.
- B. Store roll materials on end in original packaging.
- C. Store water-borne products, adhesives and primers at temperatures of 40 degrees F (5 degrees C) and above to facilitate handling. Do not allow product to freeze.
- D. Keep solvent away from open flame or excessive heat.
- E. Protect rolls from direct sunlight until ready for use.

1.10 COORDINATION

- A. Ensure continuity of the air seal throughout the scope of this section.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and products named below to establish a Standard of Quality. Other acceptable manufacturers with products,

listed in Paragraph B below, having equivalent characteristics may be submitted.

1. Basis of Design Product Selections:

- a. Manufacturer: Kemper Systems America, Inc.
- b. Product: Wall Guardian FW-100A, acrylic based.
 - 1) Refer to Section 07 21 00-Continuous Thermal Insulation for list of approved products tested in compliance with NFPA 285 with this membrane.
- c. Air leakage of building assembly in accordance with ASTM E2357, Specimen 2: 0.0004 cfm/ft² @ 1.57 psf @ 20 mils dry.
- d. Air permeance in accordance with ASTM E2178: 0.0001 cfm/ft² @1.57 psf @ 20 mils dry.
- e. Water vapor permeance in accordance with ASTM E96 – Water Method: 11.5 perms @ 22 mils dry.
- f. Water vapor permeance in accordance with ASTM E96, Dessicant Method: 0.96 perms @ 22 mils dry.
- g. Water resistance in accordance with AATCC 127-03: Pass.
- h. Fastener sealability in accordance with ASTM D1970-01: Pass.
- i. VOC content: 50 g/L.
- j. Pull adhesion in accordance with ASTM D4541-05: ≥ 110 kPa.
- k. Crack bridging in accordance with ICC ES AC212: Pass.
- l. Fire test in accordance with NFPA 285: Passed.
- m. Exposure: 6 months.
- n. In service temperature: Zero sag at 180 Degrees F.
- o. Self-adhering membrane for transition, joint treatment, inside and outside corners, window and door openings, closure between air barrier membrane and storefront, and door frames and at other locations noted shall be UT-40 universal tape, 40 mil thick polyester-backed synthetic butyl rubber-based adhesive membrane.

Note: Verify compatibility of self-adhering membrane with roof membrane, and any other material system membrane is secured to.

- 1) Tensile strength: 150 psi.
 - 2) Elongation: 500 percent min.
 - 3) Permeance: 0.13 perms.
 - 4) Pliability: Pass.
 - 5) In-service temperature: -30 degrees F to 250 degrees F.
 - 6) Roll size widths: Provide roll size widths as required from 4 inches up to 36 inches.
- p. Primer:
 - 1) Primer for self-adhering membrane for application below 32 degrees F, gypsum sheathing, concrete or masonry surfaces, AP-42 primer, 0 g/L.
 - q. Sealants:
 - 1) Sealants shall be compatible with air barrier systems and shall be approved by the air barrier manufacturer.

- 2) Liquid Tape Sealant:
 - a) Kemper Systems America, Inc. GreatSeal LT100 Liquid Tape: Polyether-based, moisture curing, elastomeric vertical seam sealer. VOC content: 15.7 g/L < 250 g/L.
 - b) Primers as recommended by sealant manufacturer for surfaces to be sealed.
 - c) Backer rods: As recommended by sealant manufacturer.
 - 3) Sealant:
 - a) Kemper Systems America, Inc GreatSeal PE-150: Polyether-based sealant. VOC content 18.26 g/L < 250 g/L.
 - b) Primers as recommended by sealant manufacturer for surfaces to be sealed.
 - c) Backer rods: As recommended by sealant manufacturer.
- B. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers listed below:
1. Manufacturer: W.R. Meadows, Inc.
 - a. Product: Air-Shield LMP (Gray) Low Version VOC.
 - 1) Refer to Section 07 21 00-Continuous Thermal Insulation for list of approved products tested in compliance with NFPA 285 with this membrane.
 - b. Air leakage of building assembly in accordance with ASTM E2357, Specimen 2: 0.00052 cfm/ft² @ 1.57 psf @ 45 mils dry.
 - c. NOTE: Provide all materials used in the wall assembly tested in accordance with ASTM E2357, Specimen 2.
 - d. Air permeance in accordance with ASTM E2178: <0.00022 cfm/ft² @ 1.57 psf @ 20 mils dry.
 - e. Water vapor permeance in accordance with ASTM E96 – Water Method: 10.47 perms @ 47.6 mils dry.
 - f. Fire test in accordance with NFPA 285: Pass.
 - g. Fastener sealability in accordance with ASTM D1970-01: Pass.
 - h. Pull adhesion in accordance with ASTM D4541-05.
 - i. VOC content: 40 g/L.
 - j. Exposure: 6 months.
 - k. In service temperature: Zero sag at 175 Degrees F.
 - l. Self-adhering membrane for transition, joint treatment, window and door openings, inside and outside corners and where noted shall be a high temperature membrane 40 mil thick polyester-backed synthetic butyl rubber-based adhesive membrane. Note: Verify compatibility of self-adhering membrane with roof membrane, and any other material system membrane is secured to.
 2. Manufacturer: Sika Corp.
 - a. Product: Sikagard 535.

- 1) Refer to Section 07 21 00-Continuous Thermal Insulation for list of approved products tested in compliance with NFPA 285 with this membrane.
 - b. Air leakage of building assembly in accordance with ASTM E2357, Specimen 2: 0.0026 cfm/ft² @ 1.57 psf @ 20mils dry
 - c. NOTE: Provide all materials used in the wall assembly tested in accordance with ASTM E2357, Specimen 2.
 - d. Air permeance in accordance with ASTM E2178: <0.00018 cfm/ft² @ 1.57 psf @ 10 mils dry.
 - e. Water vapor permeance in accordance with ASTM E96 – Water Method: 6 perms @ 20 mil dry.
 - f. Fire test in accordance with NFPA 285: Pass.
 - g. Fastener sealability in accordance with ASTM D1970-01: Pass.
 - h. Pull adhesion in accordance with ASTM D4541-05: Pass
 - i. VOC content: 80 g/L.
 - j. Exposure: 6 months.
 - k. Self-adhering membrane for transition, joint treatment, window and door openings, inside and outside corners and where noted shall be SikaMultiSeal 515 membrane 40 mil thick polyester-backed synthetic butyl rubber-based adhesive membrane. Note: Verify compatibility of self-adhering membrane with roof membrane, and any other material system membrane is secured to.
- C. Substitutions per Section 01 60 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the Work of this section. Notify Architect in writing of any discrepancies. Commencement of the work or any parts thereof shall mean acceptance of the prepared substrate.

3.02 PREPARATION

- A. All surfaces must be sound, dry, clean and free of oil, grease, dirt, excess mortar or other contaminants. Fill spalled areas in substrates to provide an even plane.
- B. Mortar joints in concrete block and form tie holes/voids in poured concrete shall be filled flush and smooth and allowed to be cured for a minimum of 24 hours.
- C. All joints between gypsum sheathing, masonry and concrete and other substrate joints up to ¼- inch wide shall be treated with GreatSeal LT-100 Liquid Tape.
 1. Use a quality caulking gun to ensure ease of application.
 2. Application shall occur only when temperatures are above 40 degrees F and inclement weather is not predicted.
 3. Cut the plastic nozzle at a 45- degree angle or use special nozzle.

4. Begin gunning the material filling the joint from the bottom to the surface ensuring there are no voids or air pockets in the joint.
 5. Applied in a 1/4 -inch bead.
 6. Tool to 3/4 inch by 1/16 -inch cap seal that becomes tack free in 20 minutes.
 7. It cures to a firm rubber seal in one hour.
 8. For best finishing performance, do not allow un-tooled beads to stand for more than 10 minutes.
- D. At joints (change in plane, change in substrate, control joints, loose fitting penetrations) between gypsum sheathing, masonry and concrete and other substrates wider than 1/4 inch shall be sealed with:
1. UT 40 Tape, overlapping each side of joint a minimum of 4 inches installed over LT-100 liquid tape and backer rod.
- E. At building expansion joints install UT-40 Tape overlapping each side joint a minimum of 4 inches. Leave the release paper on the tape only for the width of the expansion joint.
- F. At joints between air barrier membrane and storefront frames, door frames where transition membrane is lapped onto the frame, install a continuous fillet bead of GreatSeal PE-150 sealant and backer rod behind the transition membrane.
1. Where transition membrane is not lapped onto storefront frames, door frames seal joint between frames and air barrier membrane/transition membrane with GreatSeal PE 150 sealant and backer rod as secondary sealant and interior sealant.
 - a. Sealant shall be compatible with air barrier/transition membrane.

3.03 PRIMER FOR TRANSITION MEMBRANE (SELF-ADHERING TYPE ONLY)

- A. Apply primer for self-adhering membranes at rate recommended by manufacturer.
- B. Apply primer to all areas to receive transition sheet membrane as indicated in Drawings by roller or spray and allow minimum 30-minute open time. Primed surfaces not covered by transition membrane during the same working day must be re-primed.

3.04 TRANSITION MEMBRANE (SELF-ADHERING TYPE)

- A. Align and position self-adhering transition membrane, remove protective film and press firmly into place. Center tape over area to be sealed. Ensure minimum 4- inch overlap at all end and side laps unless otherwise noted. Cover horizontal joints first then vertical joints.
 1. Transition membrane shall extend a minimum of 3 inches onto primed surface of sheathing, concrete block, or concrete. Seal edges of transition membrane with a continuous bead of GreatSeal LT-100 prior to the application of the air barrier membrane.

- B. Tie in to roofing system and at the interface of dissimilar materials as indicated in Drawings.
 - 1. Verify compatibility of all materials that membrane comes in contact with.
- C. Promptly roll all laps and membrane with a counter top roller to affect seal.
- D. Ensure all preparatory work is complete prior to applying liquid membrane.
- E. Seal storefront frames (window and door frames), and steel door frames using UT 40 tape installed behind air barrier. Install a continuous fillet bead of GreatSeal PE-150 sealant and backer rod behind the tape at storefront frames (window and door frames). At steel door frames, install a fillet bead of GreatSeal PE-150 behind the tape. Lap tape over storefront frames (window and door frames), and steel door frames as detailed. Extend tape behind air barrier minimum 4 inches. Provide GreatSeal PE-150 sealant and backer rod around the perimeter of the storefront frames (window and door frames), on the interior side of the frames.
 - 1. Where sealant comes in contact with any surface or edge of the UT 40 tape provide Great Seal PE-150 sealant.
 - 2. Where transition membrane is not lapped onto any of the frames noted above, seal joint between frames and air barrier membrane/transition membrane with GreatSeal PE 150 sealant and backer rod as secondary sealant and interior sealant.
- F. At all inside corners, apply a fillet shaped bead of GreatSeal PE-150 sealant directly behind the transition membrane.

3.05 PRIMARY AIR BARRIER

- A. Apply by spray, a complete and continuous unbroken film at a temperature of 40 degrees F and rising with less than a 30 percent chance of rain in the next 24 hours:

Select either paragraph 1 or 2 below or both based on project requirements

- 1. Exterior Gypsum Sheathing: Note applied mil thickness shall match ABAA system evaluation per ASTM E2357.
 - a. Kemper Systems America, Inc., FW-100A at the minimum rate of 40 mils wet, 20 mils dry
 - b. W.R. Meadows, Inc. Air-Shield LMP (gray) at the minimum rate of 90 mils wet, 45 mils dry.
 - c. Sika Corp, Sikagard 535 at the minimum rate of 40 mils wet, 20 mils dry.
 - d. Spray around all projections, including masonry veneer anchors, ensuring a complete and continuous air seal.
- 2. Concrete Masonry Unit (CMU), Concrete: Note: Applied mil thickness shall match ABAA system evaluation per ASTM E2357.
 - a. Kemper Systems America, Inc., FW-100A at the minimum rate of 40 mils wet, 20 mils dry.
 - b. W.R. Meadows, Inc., Air-Shield LMP (gray) at the minimum rate of 90

mils wet, 45 mils dry.

- c. Sika Corp, Sikagard 535 at the minimum rate of 40 mils wet, 20 mils dry.
- d. Spray around all projections including masonry veneer anchors ensuring a complete and continuous air seal.

3.06 INSPECTION

- A. Notify Architect when sections of work are complete so as to allow for review prior to installing continuous insulation. The manufacturer's representative shall be on site to review the installation along with the Architect.

3.07 PROTECTION OF FINISHED WORK

- A. Liquid membranes are not designed for permanent exposure. Cover the liquid membrane, as recommended by the manufacturer, within the following time frames. Contractor shall verify the number of calendar days with the air barrier manufacturer:
 - 1. Cover the Kemper Systems America, Inc. FW-100A material within 180 calendar days after installation.
 - 2. Cover W.R. Meadows, Inc. Air-Shield LMP (gray) within 180 calendar days after installation.
 - 3. Cover Sika Corp, Sikagard 535 within 180 calendar days after installation.
 - 4. Transition membranes shall be covered within 180 days after installation
- B. Prepare, treat and seal vertical and horizontal surfaces at terminations and penetrations through the air barrier and at protrusions according to air barrier manufacturer's written instructions.

3.08 SCHEDULE

- A. Install liquid membrane system over the entire surface of the glass-faced sheathing in the following area. Seal any masonry anchor penetrations air tight by coating the back of the anchor plate with sealant compatible with fluid applied air barrier membrane.
 - 1. In the masonry cavity wall.
- B. Install liquid membrane system over the entire surface of the outer surface of the inner wythe of masonry. Seal any masonry anchor penetrations air tight.
 - 1. Seal any masonry anchor penetrations air tight by coating the back of the anchor plate with sealant compatible with fluid applied air barrier membrane. Seal all pre-drilled holes prior to installing masonry expansion anchors used to secure masonry anchors to concrete block.
- C. Install liquid membrane system over the entire surface of the glass-faced gypsum sheathing in the following area:
 - 1. Behind the metal wall and soffit panels.

- a. Where metal furring is installed seal head of all fasteners used to secure framing to the wall.

- D. Hollow Metal Door Frames: Seal door frame to wall surface with transition membrane and sealant.

- E. Wall and Roof Junction: Seal wall to roof with transition membrane.

- F. Seal the top of sheathing to the underside of the roof systems with sealant.

- G. Openings: Seal around the perimeter of all openings with transition membrane.

- H. Perimeter wood nailers at wall openings: Cover all exposed surfaces of wood nailers with transition membrane. Extend membrane over sheathing, masonry and metal framing as shown. Prime surface.

- I. Aluminum storefront frames: Seal frames to the wall surface with transition membrane, sealant and backer rod.
 - 1. Verify air barrier sealants that are not compatible with sealants used to install storefront framing do not come in contact with sealants used to seal the storefront framing.

 - 2. Where transition membrane is not lapped onto storefront frame noted above, seal joint between frames and air barrier membrane/transition membrane with GreatSeal PE 150 sealant and backer rod as secondary sealant and interior sealant.

END OF SECTION

SECTION 07 40 00 – CLADDING SUPPORT SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cladding support system consisting of zee furring, J-tracks and corner angles for securing:
 - 1. Metal wall panels to walls that require continuous rigid insulation.
- B. Substrate:
 - 1. Exterior sheathing over metal stud framing.
- C. Structural engineering services provided by cladding support metal framing fabricator.

1.02 RELATED SECTIONS

- A. Section 05 40 00 - Cold-Formed Metal Framing: Securing cladding support system to exterior steel stud curtain wall framing.
- B. Section 06 16 43 – Gypsum Sheathing: Fastening cladding support system through exterior gypsum sheathing.
- C. Section 07 21 00 – Continuous Thermal Insulation: Cladding support framing members sized to match thickness of continuous insulation.
- D. Section 07 27 26 – Fluid-Applied Membrane Air Barrier: Compatibility of thermal tape to fluid-applied air barrier membrane including any sealants provided by the cladding support manufacturer.
- E. Section 07 42 13 – Metal Wall and Soffit Panels: Wall cladding system.
 - 1. Securing horizontal metal wall panels to horizontal framing specified in this section.

1.03 REFERENCES

- A. 2015, IECC International Energy Conservation Code.
- B. ASHRAE STANDARD 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings. Edition as referenced in the applicable IECC.
- C. ASTM Standards:
 - 1. ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 2. ASTM C1363 Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus.
 - 3. ASTM D1667 Standard Specification for Flexible Cellular Materials-Poly (Vinyl

Chloride) Foam (Closed Cell).

1.04 DESIGN REQUIREMENTS

- A. Cladding support fabricator is responsible for designing system, including anchorage to the following substrates and required modifications to meet specified requirements and maintain visual design concepts.
 - 1. Steel stud framing.
- B. Cladding support fabricator shall employ a professional engineer, licensed to practice engineering in jurisdiction where Project is located to engineer each cladding support system and attachment to substrate including:
 - 1. Frequency and spacing of horizontal cladding support framing.
- C. Structural Design: Cladding support system shall be designed to withstand effects of load and stresses from dead loads, wind loads, (snow and ice loads where applicable) as indicated on Structural General Notes and the following deflection criteria:
 - 1. Deflection of L/180 for metal wall panels.
- D. Attachment System:
 - 1. No framing component shall penetrate the layer of continuous exterior insulation.
- E. Performance Requirements:
 - 1. Attachment System Performance: Constructed system shall comply with applicable ANSI/ASHRAE 90.1 definition of continuous insulation.
 - 2. No thermal bridges other than fasteners and service openings.
 - 3. Thermal Performance:
 - a. Provide thermal performance data R and U values for exterior wall assembly as shown on the contract documents using thermal modelling software as recommended by cladding support manufacturer based on the following standards:
 - 1) Applicable climate zone where the project is located.
 - 2) Applicable IECC.
 - 3) Applicable ASHRAE 90.1.
- F. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cladding support system by employing a qualified professional engineer, licensed in the state in which project is located to prepare and sign and seal design calculations, Shop Drawings and other structural data.

1.05 SUBMITTALS

- A. Product Data: For each type of product.

1. Provide documentation that cladding support system complies with the referenced IECC code and relevant ASTM Standards. Verify mechanical properties, coatings, dimensions, and labeling are checked. Installation instructions shall be included.
- B. Provide engineered design and drawings for gage and spacing of cladding support system including fastener type and spacing required to secure cladding support system to the following substrates:
 1. Exterior sheathing over metal stud framing.
- C. Structural Calculations:
 1. Submit comprehensive analysis of design loads, including dead loads, live loads and wind loads and attachment to wall signed and sealed by a licensed engineer in the applicable State the project is located in.
- D. Manufacturer's Certification: Submit manufacturer's certification of product compliance with codes and standards along with product literature and data sheets for specified products.
- E. Provide written certification that thermal tape and any sealants required by the installation of the cladding support system are compatible with fluid applied membrane air barrier specified in Section 07 27 26.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with at least two years of documented experience.
- B. Installer Qualifications: Engage an experienced Installer who has completed cladding support metal framing similar in material, design and extent to that indicated for this Project and with a record of successful in-service performance.
 1. Install system in strict compliance with manufacturer's installation instructions.
 2. Have not less than three years of documented experience.
- C. Professional Engineer Qualifications: A professional engineer legally authorized to practice in the jurisdiction where Project is located and experienced in providing engineering services of the kind indicated that have resulted in the installation of cladding support framing similar to this Project in material, design and extent and that have a record of successful in-service performance.
- D. Engineering Responsibilities: Preparation of Shop Drawings, design calculations and other structural data.
- E. Pre-Installation Meeting:
 1. Participants: Authorized representatives of the General Contractor, Owner, Architect, Manufacturer's technical representative for each product specified, installation subcontractors for continuous thermal insulation, cladding support system

and:

a. Metal wall panels.

2. Meeting Timing: Minimum 4 weeks prior to beginning work of this Section and related work that may affect work of this Section.
3. Review metal wall framing assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.
4. Review and document methods, procedures and manufacturer's installation guidelines and safety procedures for insulation, flashings, support framing, attachment system, finish panels, and penetration and gap sealant.
5. Review construction schedule and confirm availability of products, applicator/installer personnel, equipment and facilities.
6. Review governing regulatory requirements and requirements for insurance and certificates.
7. Review field quality control procedures.

F. Mock-Ups:

1. Mock-up complete system at location as directed by Architect.
2. Coordinate mock-up with the following Section:
 - a. Section 07 27 26 Fluid-Applied Membrane Air Barrier mock up requirements.
3. Mock-up shall demonstrate prepared substrate, support/attachment framing, insulation, façade finish, outside corner, inside corner, penetrations, exterior finishes and aesthetic appearance.
4. Verify mock-up as conforming to manufacturer's instructions and provisions of Contract Documents.
5. Do not begin work of this Section until façade mock-up has been inspected and approved by manufacturer's representative on site and Architect's acceptance of mock-up is given in writing.
6. Protect and maintain accepted mock-up as standard of quality for work of this Section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original unopened containers and packaging with labels clearly identifying product name and manufacturer.
- B. Deliver components and other manufactured items or accessories without damage or deformation.
- C. Storage: Store materials in clean, dry, and level interior areas or outdoor areas for limited

duration in accordance with manufacturer's written instructions.

- D. Protect components and auxiliary accessories during transportation, handling, and installation from moisture, excessive temperatures and other construction operations in accordance with manufacturer's written instructions.
- E. Handle components in strict compliance with manufacturer's written instructions and recommendations, and in a manner to prevent bending, warping, twisting, and surface, edge or corner damage.

1.08 SITE CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of this Work in accordance with manufacturer's written installation instructions and warranty requirements.

1.09 SEQUENCING

- A. Coordinate construction to ensure that assemblies fit properly to supporting and adjoining construction; coordinate schedule with construction in progress to avoid delaying work.

PART 2 PRODUCTS

2.01 MANUFACTURER AND PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and products named below to establish a standard of quality. Other Manufacturer's offering equivalent systems may submit as a substitution request in accordance with General Conditions and Division 01 requirements provided deviations are minor and does not change the concept as expressed in Contract Documents as judged by Architect.

- 1. Manufacturer: The Steel Network, Inc.
- 2. Products: ThermaFast Cladding Support System. A pre-engineered system designed to support rigid insulation, cladding material and resist wind loads. System is made from structural grade steel slotted to minimize thermal conductivity with a 1- inch thermal tape preinstalled on each piece for an integral continuous thermal break.

- a. Components:

- 1) ThermaFast J-Track.
- 2) ThermaFast Z-Track.
- 3) ThermaFast Corner Angle.

2.02 CLADDING SUPPORT SYSTEM

- A. Steel material and coating: ASTM A1003/A1003M Structural Grade 50 Type H, ST50H 50ksi minimum yield strength, 65ksi minimum tensile strength, with ASTM A653/A653M G90 hot dipped galvanized coating.
 - 1. Thickness: 54 mil minimum thickness (16-gauge, 0.0566- inch design thickness).

2. Depth of Z-track and J-Track based on depth of insulation specified.
 - a. 2 inches.
- B. Thermal Tape:
 1. Size: 1/16- inch thick by 1 inch wide.
 2. Density per ASTM D1667: 15 lbs/ft³.
 3. Thermal conductivity, k factor per ASTM C518: 0.3.
- C. Fasteners: Hot dipped galvanized gasketed fasteners.
 1. Metal stud framing: Self-drilling, size and gauge based on design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, for compliance with requirements and other conditions affecting performance of the work. Do not begin installation until substrates have been properly prepared.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean and prepare surfaces using the methods recommended by the manufacturer before installation.

3.03 INSTALLATION

- A. Install in J-track, Z-track and Corner angles in accordance with manufacturer's instructions and approved submittals, and in proper relationship with adjacent construction.
 1. Coordinate installation of Z- track and J- track with board insulation specified in Section 07 21 00.
 - a. Attach cladding support system to steel stud backup with minimum (1) #10-16 self-drilling gasketed screws to each stud. (2) screws may be required for high design wind pressures per manufacturer's recommendations.
- B. Install wall panels in accordance with Section 07 42 13.

3.04 PROTECTION

- A. Protect installed products until completion of project. repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 42 13 - METAL WALL AND SOFFIT PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concealed fastener metal wall and soffit panels.
- B. Subgirts installed behind wall panels.

1.02 RELATED SECTIONS

- A. Section 05 40 00 – Cold Formed Metal Framing: Installing metal wall panels over metal stud framing.
 - 1. Installing metal soffit panels to metal framing support system as detailed.
- B. Section 07 21 00 – Continuous Thermal Insulation: Installing metal wall panels over board insulation.
- C. Section 07 40 00 – Cladding Support System: Installing metal wall panels to metal Z and J tracks.
- D. Section 07 62 00 – Sheet Metal Flashings and Trim: Sheet metal copings, and flashings.
- E. Section 07 90 00 – Joint Protection: Field-applied joint sealants.

1.03 REFERENCES

- A. American Architectural Manufacturer's Association (AAMA):
 - 1. AAMA 621 - Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.
- B. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International (ASTM):
 - 1. ASTM A755/A755M - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products.
 - 2. ASTM A792/A792M – Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 3. ASTM C920 - Specification for Elastomeric Joint Sealants.
 - 4. ASTM E72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.

- D. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):
 - 1. Architectural Sheet Metal Manual.

1.04 PERFORMANCE REQUIREMENTS

- A. General: Provide metal wall and soffit panel assemblies meeting performance requirements as determined by application of specified tests by a qualified testing agency on manufacturer's standard assemblies.
- B. Design Requirements:
 - 1. Manufacturer is responsible for designing system, including anchorage to cladding support system and necessary modifications to meet specified requirements and maintain visual design concepts.
 - 2. Manufacturer shall employ a professional engineer, licensed to practice engineering in jurisdiction where Project is located, to engineer each component of metal wall and soffit panel system:
 - a. Where noted engineer the metal subgirt framing and the metal subgirt spacing behind wall panels.
 - 3. Structural Performance: Provide metal wall and soffit panel assemblies capable of withstanding the effects of indicated loads and stresses within limits and under conditions indicated, per ASTM E72:
 - a. Wind Loads: Refer to Structural Drawings for wind loads.
 - b. Limits of Deflection: Metal wall panel and soffit panel assembly shall withstand scheduled wind pressure with the following allowable deflection:
 - 1) Maximum allowable deflection limited to L/180 deflection of panel perimeter normal to plane of wall and soffit with no evidence of failure.
 - c. Coordinate with Section 07 40 00-Cladding Support System for spacing of framing system based on wind loads.
 - 4. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction.
 - 5. Vertical deflection of back up wall assembly: Accommodate for vertical deflection of back up wall system with in metal wall panels.
 - 6. Wall systems that incorporate foam plastic insulation must be tested by the foam plastic supplier in accordance with NFPA-285.

1.05 QUALITY ASSURANCE

- A. Manufacturer/Source: Provide metal wall panel and panel accessories from a single manufacturer.
- B. Installer Qualifications: Experienced Installer with minimum of 5 years experience with

successfully completed projects of a similar nature and scope.

1.06 PREINSTALLATION MEETING

- A. Convene four weeks prior to commencing work of this section, under provisions of Section 01 33 00 – Administrative Requirements: Pre-installation meeting. Attendance by the manufacturer's representative along with the installer is mandatory including other trade contractors.
 - 1. Coordinate cladding support system in relation to metal wall and soffit panel assembly.
 - 2. Coordinate installation of building air and water barrier behind metal wall and soffit panel assembly.
 - 3. Coordinate window, door and other openings and penetrations of metal wall panel assembly.

1.07 SUBMITTALS

- A. Product Data: Manufacturer's data sheets, for specified products.
 - 1. Include data indicating compliance with performance requirements.
- B. Shop Drawings: Provide shop drawings prepared by manufacturer or manufacturer's authorized Installer. Include full elevations showing openings and penetrations. Include details of each condition of installation and attachment. Provide details at a minimum scale of 1-1/2-inch per foot (1:8) of all required trim and extrusions needed for a complete installation.
 - 1. Indicate points of supporting structure that must coordinate with metal wall and soffit panel assembly installation.
 - 2. Indicate details of fastening, including clip spacing, supported by load span tables that include an evaluation of clip and panel side joint interaction.
 - 3. Indicate details where wall panels span over deflection joints in back up wall assembly, provide appropriate trim, fasteners and clips as required to allow back up wall to move (deflect) without damaging wall panels.
- C. Structural Calculations:
 - 1. Submit Panel manufacturer's comprehensive analysis of design loads, including dead loads, live loads, wind loads and thermal movement.
 - 2. Submit façade attachment/support framing system including manufacturer's comprehensive analysis of design loads, including dead loads, live loads, wind loads and thermal movement, signed and sealed by a licensed engineer in the applicable State.
- D. Samples for Initial Selection: For each product specified. Provide representative color charts of manufacturer's full range of colors.
- E. Samples for Verification: Provide 12-inch section of panel(s) showing finishes. Provide

12-inch long pieces of trim pieces and other exposed components.

1.08 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Indicating compliance of products with requirements, from a qualified independent testing agency.
- B. Qualification Information: For Installer firm.
- C. Manufacturer's Warranty: Submit sample warranty.

1.09 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Protect metal wall and soffit panel products during shipping, handling, and storage to prevent staining, denting, deterioration of components or other damage.
 - 1. Deliver, unload, store and erect metal wall and soffit panel products and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations.

1.11 WARRANTY

- A. Special Manufacturer's Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace components of metal wall and soffit panel assemblies that fail in materials and workmanship within two years from date of Substantial Completion.
- B. Special Panel Finish Warranty: On manufacturer's standard form, in which manufacturer agrees to repair or replace metal wall and soffit panels that evidence deterioration of finish within the following periods from the date of substantial completion:
 - 1. Warranty Period: 20 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be submitted in accordance with Conditions of the Contract and appropriate Division 1 sections.
 - 1. Manufacturer: PAC-CLAD.

2.02 METAL PANEL MATERIALS

- A. Metallic-Coated Steel Face Sheet: Coil-coated, ASTM A755/A755M.

1. Aluminum-zinc alloy-coated Steel Sheet: ASTM A 792/A 792 M, Class AZ50 Grade 50 (Class AZM150, Grade 275), structural steel quality.
2. Face Sheet: Minimum 22 gauge nominal uncoated thickness.
3. Surface: Smooth.

2.03 CONCEALED FASTENER METAL WALL PANELS

- A. Metal Wall Panels – General: Factory-formed, concealed fastener panels with interconnecting side joints, fastened to supports with concealed fasteners, with factory-applied sealant in side laps when required to meet performance requirements.
- B. Flush-joint profile raised flat pan MWP# 1
 1. Basis of Design Product: PAC-CLAD, Flush Solid Panel
 - a. Acceptable Manufacturers/Products: CENTRIA IW-10A.
 - 1) Panel Coverage: 12 inches
 - 2) Panel Height: 1.50 inches.
 2. Panel Coverage: 12 inches.
 3. Panel Height: 1 inch.

2.04 CONCEALED FASTENER METAL SOFFIT PANELS

- A. Metal Soffit Panels – General: Factory-formed, concealed fastener panels with interconnecting side joints, fastened to supports with concealed fasteners, with factory-applied sealant in side laps when required to meet performance requirements.
 1. Flush-joint profile raised flat pan MSP# 1:
 - a. Basis of Design Product: PAC-CLAD Flush Solid Panel.
 - b. Panel Coverage: 12 inches.
 - c. Panel Height: 1 inches.
 2. Acceptable Manufacturers/Products:
 - a. CENTRIA IW-10A.
 - 1) Panel coverage: 12 inches.
 - 2) Panel height: 1.5 inches.

2.05 METAL PANEL ACCESSORIES

- A. Metal Panel Accessories – General: Provide complete metal wall and soffit panel assembly incorporating trim, soffits, sills, inside and outside corners, expansion joint covers and miscellaneous flashings. Provide manufacturer's factory-formed clips, shims, flashings, gaskets, lap tapes, closure strips, and caps for a complete installation. Fabricate and in-

stall accessories in accordance with SMACNA Manual.

- B. Mitered Corners: Structurally-bonded horizontal interior and exterior trimless corners matching metal wall panel material, profile, and factory-applied finish, fabricated and finished by metal wall panel manufacturer.
 - 1. Welded, riveted, fastened or field-fabricated corners do not meet the requirements of this specification.
- C. Formed Flashing and Trim: Match material, thickness, and color of metal wall and soffit panel face sheets.
- D. Sealants: Type recommended by metal wall and soffit panel manufacturer for application, meeting requirements of Section 07 90 00 – Joint Protection.
- E. Flashing Tape: 4-inch wide self-adhering butyl flashing tape.
- F. Fasteners – General: Self-tapping gasketed screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided for miscellaneous applications, supply corrosion-resistant fasteners with heads matching color of metal wall panels by means factory-applied coating.
- G. Concealed Clips: Galvanized steel, 0.051 inch/16 ga. thick, designed to allow unimpeded thermal movement of panel.

2.06 METAL SOFFIT PANEL ACCESSORIES

- A. Formed Flashing and Trim: Match material, thickness, and color of metal wall panel face sheets.
- B. Sealants: Type recommended by metal wall panel manufacturer for application, meeting requirements of Section 07 90 00 – Joint Protection.
- C. Flashing Tape: 4-inch wide self-adhering butyl flashing tape.
- D. Fasteners – General: Self-tapping gasketed screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided for miscellaneous applications, supply corrosion-resistant fasteners with heads matching color of metal wall panels by means factory-applied coating.

2.07 SECONDARY SUBGIRT FRAMING

- A. Refer to Section 07 40 00 – Cladding Support System.
 - 1. Z and J tracks.
- B. Metal Subgirt Framing
 - 1. Wall panels installed over metal stud framing.
 - a. Where wall panels are installed horizontally over metal stud framing provide the following:

- 1) Horizontal Z and J tracks: Refer to Section 07 40 00 Cladding Support System.
- 2) Vertical subgirts: Minimum 16 gauge G90 galvanized 3/4 inch deep subgirts.
 - a) Spacing of subgirts to be determined by metal wall panel engineer.
 - b. Where soffit panels are installed vertically over metal stud fanning provide the following:
 - 1) Horizontal metal framing as detailed.

2.08 METAL WALL AND SOFFIT PANEL FINISHES

A. Exposed Coil-Coated Finish System:

1. Fluoropolymer Two-Coat System: 0.2 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621.
2. Color:
 - a. Exterior Surface: Slate gray.
 - 1) Panel: Color as selected by Architect.
 - 2) Interior Surface: Manufacturer's standard primer color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine metal wall and soffit panel substrate with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation of metal wall and soffit panels.
- B. Wall and Soffit Substrate: Confirm that wall and soffit substrate is within tolerances acceptable to metal wall and soffit panel system manufacturer.
 1. Maximum substrate and framing deviations from flat plane acceptable:
 - a. 1/4 inch in 20 feet vertically or horizontally.
 - b. 1/2 inch across building elevation.
 - c. 1/8 inch in 5 feet.
- C. Metal Z and J tracks framing: Inspect metal Z and J track framing that will support metal wall and soffit panels to determine if support components are installed as indicated on approved shop drawings. Confirm presence of acceptable framing members at recommended spacing to match installation requirements of metal wall and soffit panels.
- D. Install secondary subgirt framing over metal Z and J tracks as specified..

- E. Air/Moisture Barriers: Confirm that work has been completed, inspected, and tested as required.
- F. Openings: Verify that penetrations match layout on Shop Drawings.
- G. Installer shall notify the General Contractor in writing of out-of-tolerance work and other deficient conditions prior to proceeding with metal wall and soffit panel installation.
- H. Correct out-of-tolerance work and other deficient conditions prior to proceeding with metal wall panel system installation.

3.02 METAL WALL AND SOFFIT PANEL INSTALLATION

- A. General: Install metal wall and soffit panels in accordance with approved shop drawings and manufacturer's recommendations. Install metal wall and soffit panels in orientation, sizes, and locations indicated. Anchor metal wall and soffit panels and other components securely in place. Provide for thermal and structural movement
- B. Attach panels to framing using recommended clips, screws, fasteners, sealants, and adhesives indicated on approved shop drawings.
 - 1. Fasteners for Steel Wall and Soffit Panels: Stainless-steel for exterior locations and locations exposed to moisture; carbon steel for interior use only.
 - 2. Fasten metal wall panels to supports with concealed clips at each joint at location, spacing and with fasteners recommended by manufacturer. Install clips to supports with self-tapping fasteners.
 - 3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
 - 4. Dissimilar Materials: Where elements of metal wall panel system will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.
- C. Joint Sealers: Install joint sealants where indicated on approved Shop Drawings.

3.03 ACCESSORY INSTALLATION

- A. General: Install metal wall and soffit panel accessories with positive anchorage to building and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install related flashings and sheet metal trim per requirements of Section 07 62 00 – Sheet Metal Flashing and Trim.
 - 2. Install components required for a complete metal wall and soffit panel assembly, including trim, corners, lap strips, flashings, sealants, fillers, closure strips, and similar items.
 - 3. Comply with performance requirements and manufacturer's written installation instructions.

4. Provide concealed fasteners except where noted on approved Shop Drawings.
5. Set units true to line and level as indicated.
6. Where wall panels span over deflection joints in back up wall assembly, provide appropriate trim, fasteners and clips as required to allow back up wall to move (deflect) without damaging wall panels.

3.04 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a service representative authorized by metal wall panel manufacturer to inspect completed installation. Submit written report.
- B. Correct deficiencies noted in manufacturer's report.

3.05 CLEANING AND PROTECTION

- A. Remove temporary protective films. Clean finished surfaces as recommended by metal wall panel manufacturer. Clear weep holes and drainage channels of obstructions, dirt, and sealant. Maintain in a clean condition during construction.
- B. Replace damaged panels and accessories that cannot be repaired by finish touch-up or minor repair.

END OF SECTION

SECTION 07 54 23 – THERMOPLASTIC-POLYOLEFIN ROOFING

PART 1 GENERAL

1.01 SUMMARY

- A. The project consists of installing a thermoplastic-polyolefin adhered roofing system as outlined below:
 - 1. Fully adhered 80 mil single-ply thermoplastic-polyolefin roof membrane.
 - 2. Coverboard.
 - 3. Roof insulation.
 - 4. Membrane flashings and accessories.

1.02 RELATED SECTIONS

- A. Section 05 31 23 – Steel Roof Decking: Steel roof deck..
- B. Section 06 10 53 - Miscellaneous Carpentry: Wood nailers, curbs, and treatment process.
 - 1. Coordinate corrosion-resistant requirements for fasteners with type of wood preservative treatment.
- C. Section 07 27 26 – Fluid-Applied Membrane Air Barrier: Verify compatibility of air barrier materials that come in contact with roof membrane.
- D. Section 07 62 00 – Sheet Metal Flashings and Trim.
- E. Section 07 72 33 - Roof Hatches.
- F. Section 22 14 00 – Facility Storm Drainage: Roof drains.
- G. Division 23 for Roof-Mounted Equipment: Flashing equipment curbs.

1.03 REFERENCES

- A. American Society of Civil Engineers
 - 1. ASCE/SEI 7, American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures.
- B. ASTM International:
 - 1. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - 2. ASTM C1177 - Standard Specification for Glass Mat Gypsum Substrate for Use

as Sheathing.

3. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
4. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
5. ASTM C1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
6. ASTM D471-Standard Test Method for Rubber Property-Effect of Liquids.
7. ASTM D573-Standard Test Method for Rubber-Deterioration in an Air Oven.
8. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
9. ASTM D751 – Standard Test Method for Coated Fabrics.
10. ASTM D1149- Standard Test Method for Rubber Deterioration-Cracking in an Ozone Controlled Environment.
11. ASTM D1204 – Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
12. ASTM D1876- Standard Test Method for Peel Resistance of Adhesives (T-Peel Test).
13. ASTM D2137- Standard Test Methods of Rubber Property-Brittleness Point of Flexible Polymers and Coated Fabrics.
14. ASTM D7635- Standard Test Method for Measurement of Thickness of Coatings Over Fabric Reinforcement.
15. ASTM D822 - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
16. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
17. ASTM D6878 - Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing.
18. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
19. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
20. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.
21. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and

Materials.

22. ASTM E408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
23. ASTM E903 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
24. ASTM E1918 - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
25. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

C. FM Global:

1. FM 4450 – Approval Standard for Class 1 Insulated Steel Roof Decks.
2. FM 4470 – Approval Standard for Class 1 Roof Covers.
3. FM 4474 – American National Standard for Evaluating the Simulated Wind Uplift Resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures.
4. Loss Prevention Data 1-28, Design Wind Loads.
5. Loss Prevention Data 1-29, Roof Deck Securement and Above-Deck Roof Components.
6. Loss Prevention Data 1-49 – Perimeter Flashing.

D. National Roofing Contractors Association:

1. NRCA - The NRCA Roofing and Waterproofing Manual.

E. Single Ply Roofing Institute:

1. SPRI ES-1 – Current Edition-American National Standard Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

F. Underwriters Laboratories Inc:

1. UL - Fire Resistance Directory Current Edition
2. UL 263 – Standard for Fire Tests of Building Construction and Materials.
3. UL 580 – Test for Uplift Resistance of Roof Assemblies.
4. UL 790 - Standard Test Methods for Fire Tests of Roof Coverings.
5. UL 1256 - Fire Test of Roof Deck Constructions.

- G. Cool Roof Rating Council (CRRC): Reflective Roof Membrane Ratings.
- H. IECC: 2015.

1.04 EXTENT OF WORK

- A. Provide all labor, material, tools, equipment and supervision necessary to complete the installation of a 80-mil thick white reinforced TPO (Thermoplastic Polyolefin) reinforced membrane Adhered Roofing System including flashings, insulation and coverboard as specified herein and as indicated on the Drawings in accordance with the manufacturer's most current specifications and details.
- B. The roofing contractor shall be fully knowledgeable of all requirements of the contract documents and shall make themselves aware of all job site conditions that will affect their work.
- C. The roofing contractor shall confirm all given information and advise the building owner, prior to bid, of any conflicts that will affect their cost proposal.

1.05 SUBMITTALS

- A. Prior to starting work, the roofing contractor must submit the following:
 - 1. Shop Drawings showing layout, details of construction and identification of materials for the following work:
 - a. Provide field, perimeter and corner fastening pattern for roof insulation in accordance with Quality Assurance Article..
 - b. Base flashings.
 - c. Crickets, saddles and tapered edge strips, including slopes.
 - A. Show valley slope on crickets. Refer to Article 3.04, E, 3.
 - d. Liquid flashing.
 - 2. Product Data: For each type of roofing product specified. Include data substantiating that materials comply with requirements.
 - a. Fasteners:
 - 1) Coordinate selection of corrosion resistant coating with Section 06 10 53. Coatings shall be compatible with preservative wood treatment and metal surfaces being secured to. Coatings shall be selected to prevent galvanic corrosion between fastener and metal surfaces.
 - 2) Manufacturer's of proprietary anti-corrosion coatings shall submit data regarding the specific performance of their products in the treated wood and any precautions or special instructions that may be applicable.
 - 3. A sample of the manufacturer's Membrane System Warranty.

4. Submit a letter of certification from the manufacturer which certifies the roofing contractor is authorized to install the manufacturer's roofing system and lists foremen who have received training from the manufacturer along with the dates training was received.
 5. Certification from the membrane manufacturer indicating the membrane thickness over the reinforcing scrim (top ply membrane thickness) is nominal 0.034 inches or thicker per ASTM D7635.
 6. Certification of the manufacturer's warranty reserve.
 7. Intent to warrant assembly letter:
 - a. The roofing manufacturer shall provide an intent to warrant assembly letter outlining in detail the assembly of the entire roof system including base flashings for the project. The assembly letter shall be on the roof system manufacturer's letterhead and signed and dated by an approved representative of the roof manufacturer. Include the project name, Architect's name and roofing installer's name on the letter.
 8. Wind-Uplift Certification; Submit data which substantiates roof system meets specified uplift requirements, along with fastening pattern for field, perimeter and corner areas.
 9. Maintenance Data: For roofing system to include in the maintenance manuals specified in Division 1.
- B. Upon completion of the installed work, submit copies of the manufacturer's final inspection to the specifier prior to the issuance of the manufacturer's warranty.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened containers or wrappings with the manufacturer's name, brand name and installation instructions intact and legible. Deliver in sufficient quantity to permit work to continue without interruption.
- B. Comply with the manufacturer's written instructions for proper material storage.
1. Store roof membrane in the original undisturbed plastic wrap in a cool, shaded area. Roof membrane that has been exposed to the elements for approximately 7 days must be prepared in accordance with roof membrane manufacturer's written instructions prior to hot air welding.
 2. Store curable materials (adhesives and sealants) between 60 degrees F and 80 degrees F in dry areas protected from water and direct sunlight. If exposed to lower temperature, restore to 60 degrees F minimum temperature before using.
 3. Store materials containing solvents in dry, well ventilated spaces with proper fire and safety precautions. Keep lids on tight. Use before expiration of their shelf life.
- C. Insulation storage.

1. Short term: Where short term outdoor storage, 2 weeks or less, is necessary whether at grade or on the roof deck, the following precautions shall be observed unless otherwise directed by the polyisocyanurate insulation manufacturer:
 - a. Place the package on raised pallets or platforms, minimum 3 inches above ground and store flat. Do not place pallets on dirt or grass.
 - b. Cut the factory packaging taking care not to cut the insulation in order to prevent condensation from occurring and cover the package and pallet with a waterproof, breathable cover such as a canvas tarpaulin that is secured in place.
 2. Where polyisocyanurate insulation is to be stored for periods longer than 2 weeks, prior to installation store insulation indoors in a dry, well ventilated warehouse.
 3. Exercise care during handling of the polyisocyanurate insulation to prevent braking or crushing of the square edges and surfaces. Remove the insulation bundles from the trucks with proper equipment. Other means of mishandling, such as pushing pallets off the truck or rolling the pallet across the roof deck is not acceptable.
- D. Any materials which are found to be damaged shall be removed and replaced at the applicator's expense.

1.07 WORK SEQUENCE

- A. Schedule and execute work to prevent leaks and excessive traffic on completed roof sections. Care should be exercised to provide protection for the interior of the building and to ensure water does not flow beneath any completed sections of the membrane system.
- B. Do not disrupt activities in occupied spaces.

1.08 USE OF THE PREMISES

- A. Before beginning work, the roofing contractor must secure approval from the General Contractor and/or the building Owner's Representative for the following:
 1. Areas permitted for personnel parking.
 2. Access to the site.
 3. Areas permitted for storage of materials and debris.
 4. Areas permitted for the location of cranes, hoists and chutes for loading and unloading materials to and from the roof.

1.09 PRE-INSTALLATION MEETINGS

- A. Pre-Installation Conference: Before installing roofing system, conduct conference at Project site to comply with requirements of Section 01 30 00 – Administrative Requirements: Pre-installation meetings. Notify participants at least 5 working days before conference.

1. Meet with Owner; Architect; Owner's insurer, if applicable; testing and inspecting agency representative; roofing Installer; roofing system manufacturer's representative; deck Installer; air barrier installer and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, installers' personnel, equipment and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and attachment to structural members.
5. Review roof slope.
 - a. Verify roofing system will provide the roof assembly fire classification as specified for the roof slope indicated.
6. Review loading limitations of deck during and after roofing.
7. Review flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing.
8. Review governing regulations and requirements for insurance, certifications, and inspection and testing, if applicable.
9. Review temporary protection requirements for roofing system during and after installation.
10. Review roof observation and repair procedures after roofing installation.
11. Document proceedings, including corrective measures or actions required, and furnish copy of record to each participant.
12. Review transition from wall air barrier to roof membrane and base flashing.
 - a. Review compatibility of all materials specified in Section 07 27 26 – Fluid-Applied Membrane Air Barrier that come in contact with roof membrane.

1.10 JOB SITE PROTECTION

- A. Do not overload any portion of the building, by either use of or placement of equipment, storage of debris or storage of materials.
- B. Protect against fire and flame spread. Maintain proper and adequate fire extinguishers.
- C. Take precautions to prevent drains from clogging during the roofing application. Remove debris at the completion of each day's work and clean drains, if required. At completion, test drains to ensure the system is free running and drains are watertight. Remove

strainers and plug drains in areas where work is in progress. Install flags or other telltales on plugs. Remove plugs each night and screen drain.

- D. Store moisture susceptible materials above ground and protect with waterproof coverings.
- E. Remove all traces of piled bulk material and return the job site to its original condition upon completion of the work.

1.11 SAFETY

- A. The roofing contractor shall be responsible for all means and methods as they relate to safety and shall comply with all applicable local, state and federal requirements that are safety related. Safety shall be the responsibility of the roofing contractor. All related personnel shall be instructed daily to be mindful of the full time requirement to maintain a safe environment for the facility's occupants including staff, visitors, customers and the occurrence of the general public on or near the site.

1.12 WORKMANSHIP

- A. Applicators installing new roof, flashing and related work shall be factory trained and approved by the manufacturer they are representing.
- B. All work shall be of highest quality and in strict accordance with the manufacturer's published specifications and to the building owner's satisfaction.
- C. There shall be a supervisor on the job site at all times while work is in progress.

1.13 QUALITY ASSURANCE

- A. The thermoplastic-polyolefin membrane roofing system shall achieve a UL Class A.
- B. FM Listing: Provide single ply membrane, base flashings, and component materials that meet requirements of FM 4450 and FM 4470 as part of a roofing system and that are listed in FM's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM markings.
 - 1. Roofing system shall be installed to meet the wind uplift load requirements based on the current ASCE/SEI 7 and design loads as shown on structural drawings.
 - a. For design pressures in the field, perimeter and corner regions multiply ultimate pressures by a factor of 2.
- C. The membrane must be manufactured by the roof membrane manufacturer. Manufacturer's supplying membrane made by others are not acceptable.
- D. Unless otherwise noted in this specification, the roofing contractor must strictly comply with the manufacturer's current specifications and details.
- E. The roofing system must be installed by an applicator authorized and trained by the manufacturer in compliance with shop drawings as approved by the manufacturer. The roofing applicator shall be thoroughly experienced and upon request be able to provide

evidence of having at least five (5) years successful experience installing single-ply TPO roofing systems and having installed at least one (1) roofing application or several similar systems of equal or greater size within one year.

- F. Provide adequate number of experienced workmen regularly engaged in this type of work who are skilled in the application techniques of the materials specified. Provide at least one thoroughly trained and experienced superintendent on the job at all times roofing work is in progress.
- G. There shall be no deviations made from this specification or the approved shop drawings without the prior written approval of the specifier. Any deviation from the manufacturer's installation procedures must be supported by a written certification on the manufacturer's letterhead and presented for the specifier's consideration.
- H. Upon completion of the installation, the applicator shall arrange for an inspection to be made by a non-sales technical representative of the membrane manufacturer in order to determine whether or not corrective work will be required before the warranty will be issued. Notify the building owner seventy-two (72) hours prior to the manufacturer's final inspection.
- I. The average thickness over scrim for the membrane must meet or exceed 0.034 inches or more for 80 mil membrane.
- J. Membrane shall meet or exceed ASTM D573, 32 weeks @ 240 degrees F.
- K. Membrane must exceed ASTM D573 of 32 weeks at no less than 52 weeks.
- L. Membrane shall exceed ASTM D6878-Xenon Arc of 10,080 kJ/m² at nm at no less than 50,000 kJ/m² at 340 nm.
- M. Minimum Roof Reflectance and Emittance based on one of the following rating systems or energy codes:
 - 1. 2015 International Energy Conservation Code (IECC), Section C402.3 Roof solar reflectance and thermal emittance:
 - a. Roofs in climate zones 1, 2 and 3 shall comply with either subparagraph 1) or 2) below:
 - 1) Three-year- aged solar reflectance of 0.55 and three-year aged thermal emittance of 0.75. Calculation of the aged SRI and aged thermal emittance shall be based on aged tested values of solar reflectance and thermal emittance as rated by the Cool Roof Rating Council (CRRC).
 - 2) Three-year-aged solar reflectance index of 64 as determined in accordance with ASTM E 1980 using a convection coefficient of 2.1 Btu/h per square foot per degree F. Calculation of the aged SRI shall be based on aged tested values of solar reflectance as rated by the Cool Roof Rating Council (CRRC).
- N. Chemical resistance:

1. The following chemical shall have a negligible effect on the roof membrane:
 - a. Animal Fat/Grease
 - b. Vegetable oils.
 - c. Soap Solutions.
 - d. Silicone oil.
 2. The following chemicals shall have limited absorption or effect on the membrane:
 - a. Mineral oils.
 3. The membrane shall not be exposed continuously to the following chemicals:
 - a. Mineral spirits
- O. Nailers: The basic attachment of the nailer shall be sufficient to carry the design wind uplift load as calculated per ASCE/SEI 7. At outside building corner regions, the nailer securement shall be designed to carry a load two times the basic nailer attachment design

1.14 JOB CONDITIONS, CAUTIONS AND WARNINGS

- A. Material Safety Data Sheets (MSDS) must be on location at all times during the transportation, storage and application of materials.
- B. When positioning membrane sheets, exercise care to locate all field splices away from low spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.
- C. When loading materials onto the roof, the roofing contractor must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.
- D. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.
- E. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.
- F. Provide protection, 3/4 inch thick plywood adhered to a one inch layer of polyisocyanurate insulation, for all roof areas exposed to traffic during construction. Plywood must be smooth and free fasteners and splinters.
- G. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.
- H. New roofing shall be complete and weather tight at the end of the work day.
- I. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact

with the roofing membrane.

1.15 WARRANTY

- A. Provide manufacturer's 20-year, Total System Warranty covering both labor and material with no dollar limitation. The maximum wind speed coverage shall be peak gusts of 72 mph measured at 10 meters above ground level. Certification is required with bid submittal indicating the manufacturer has reviewed and agreed to such wind coverage.
 - 1. Warranty shall cover 2 inch hail and 16 hours of accidental puncture per year.
- B. Pro-rated system warranties shall not be accepted.
- C. Evidence of the manufacturer's warranty reserve shall be included as part of the project submittals for the specifier's approval.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and product named. Other manufacturers with products having equivalent characteristics may be submitted as substitutions according to Conditions of the Contract and appropriate Division 1 sections, provided deviations are minor and does not change concept as expressed in Contract Documents as judged by Architect.
 - 1. Manufacturer: Carlisle SynTec.
 - 2. Product: Sure-Weld fully adhered 80 mil thermoplastic-polyolefin roof membrane.
 - a. All components of the specified roofing system shall be products of Carlisle SynTec or accepted by Carlisle SynTec as compatible.
 - b. All products (including insulation, fasteners, fastening plates, prefabricated accessories and edgings) must be manufactured and/or supplied by the roofing system manufacturer and covered by the warranty.

2.02 MEMBRANE

- A. Furnish Sure-Weld 80-mil thick white reinforced TPO (thermoplastic polyolefin) membrane as needed to complete the roofing system. Membrane thickness over the reinforcing scrim (top-ply thickness) shall be nominal 0.034 inches thick or greater. Membrane sheets in rolls 12 feet, 10 feet or 8 feet wide by 100 feet long.

TPO membrane shall meet or exceed the following properties and characteristics per ASTM D6878:

Physical Property	Test Method	80 mil TPO
Tolerance on nominal thickness, percentage	ASTM D751	+10 % to -10 %

Thickness of TPO membrane over scrim, inches on weathering side	ASTM D7635 optical method, average of 3 areas	0.034 inches
Total thickness of membrane,		80 mils
Weight of 80 mil sheet, lb/sq. ft.		0.40 lbs/sq. ft.
Breaking strength, minimum, lbf	ASTM D751 Grab Method	350 lbf. min 425 lbf. typical
Elongation at break of reinforcement, Percentage	ASTM D751 Grab Method	15 % min 25 % typical
Tearing strength, minimum, lbf	ASTM D751 procedure B Tongue Tear	55 lbf. min 130 lbf. typical
Puncture resistance, lbf	FTM 101C, Method 2031	400 lbf. min 450 lbf. typical
Brittleness point, maximum, degree F	ASTM D2137, Method B	-40 degrees F. max. -50 degrees F typical
Linear dimensional change, percentage	ASTM D1204, 6 hours at 158 degrees F	+/- 1 % max -0.2 % typical
Field seam strength, lbf/in.	ASTM D1876 tested in peel	40 lbf/in. min 70 lbf/in typical
Water vapor permeance, perms	ASTM E96, Procedure B	0.10 max perms 0.05 perms typical
Properties after heat aging Breaking strength: Elongation reinf.: Tearing strength: Weight change, percentage	ASTM D573 32 weeks at 240 degrees F.	315 minimum 13.5 minimum 33 minimum 1.0 % maximum
Properties after heat aging	ASTM D573 52 weeks at 240 degrees F.	Membrane shall remain flexible and not cracking under 10X magnification while wrapped around a 3 inch diameter mandrel.
Ozone resistance, no cracks 7X 100 pphm, 168 hours	ASTM D1149	No cracks
Resistance to water absorption after 7 days immersion at 158 degrees F, change in mass, maximum percentage one side, +/- 3.0 % max	ASTM D471	0.90 %
Radiant exposure kJ/ sq. meter at 340nm		27,720 kJ/ sq. meter at 340 nm
CRRC Solar Reflectance: Initial 3 years		0.79 0.70
CRRC Thermal Emittance: Initial 3 years		0.90 0.86
SRI:		

Initial		99
3 years		85

1. Base Flashing and Parapet Flashing to be 60-mil.

2.03 INSULATION MATERIALS

A. **Polyisocyanurate Board Insulation:** Rigid, cellular polyisocyanurate thermal insulation with core formed by using hydrocarbon blowing agents which are Montreal Protocol compliant, complying with ASTM C 1289, Type II, Class 2 in-organic facers, Grade 2 (20 psi), classified by facer type as follows:

1. Facer Type: Faced with coated polymer-bonded in-organic glass fiber mat facers on both major surfaces of the core foam. Facers shall be compatible with foam adhesive.
2. **Thickness: 4.4 inches. Install in two layers, each layer 2.2 inches thick to achieve a minimum LTTR R- value of 25.**
3. Positioning: This is the top layer with the metal deck below.
4. Board Size:
 - a. Maximum 4 foot by 8 foot where boards are mechanically attached.
 - b. Maximum 4 foot by 4 foot where boards are adhered to substrate.
5. Codes and Compliances: Provide polyisocyanurate insulating materials that comply with the following testing standards:
 - a. FM Standard 4450/4470 approval for Class 1 insulated steel, wood, concrete and gypsum roof deck construction.
 - b. UL Standard 1256 Classification, insulated metal deck construction assemblies; Construction #120 & 123.
 - c. UL Standard 790 Classification, Class A with most roof membrane system.
6. Product: **Carlisle Syntec SecurShield Polyisocyanurate Insulation.**

B. **Tapered Polyisocyanurate Board Insulation:** Rigid, cellular polyisocyanurate thermal insulation with core formed by using hydrocarbon blowing agents which are Montreal Protocol compliant, complying with ASTM C 1289, Type II, Class 2 in-organic facers, Grade 2 (20 psi):

1. Thickness: As required to provide positive slope to drains. Tapered insulation shall be installed at a minimum slope of 2 times the slope of the roof where the roof structure slopes, unless otherwise noted on the drawings. Where the roof structure is set flat, provide tapered insulation at a minimum slope of 1/4 inch per foot, unless otherwise noted on the Drawings.
2. Positioning: Position this above the ISO
3. Codes and Compliances: Provide polyisocyanurate insulating materials that comply with the following testing standards:

- a. FM Standard 4450/4470 approval for Class 1 insulated steel, wood, concrete and gypsum roof deck construction.
 - b. UL Standard 1256 Classification, insulated metal deck construction assemblies; Construction #120 & 123.
 - c. UL Standard 790 Classification, Class A with most roof membrane system.
4. Product: Product: Carlisle Syntec SecurShield Polyisocyanurate Insulation.
- C. Roof Drain Sump Insulation:
1. First layer 4 foot x 4 foot, 2.9 inches thick polyisocyanurate filler insulation complying with Article 2.03.
 2. Second layer: Tapered 1/2 inches to 1 1/2 inches, (1/2" per foot) 24 inches wide 48 inches long polyisocyanurate insulation complying with Article 2.03. Furnish four pieces at each roof drain. Miter ends of each board at 45 degrees to form a 48 inch by 48 inch square sump.
- D. Insulation Accessories:
1. General: Furnish roofing insulation accessories as recommended by insulation and roof membrane manufacturer for intended use and compatible with sheet roofing material.
 2. Insulation Fasteners: Provide fasteners as described below for each specific deck type and to comply with Factory Mutual recommendations for specified wind uplift resistance. All fasteners shall comply with the corrosion resistance requirements of Factory Mutual Standard 4470. Fasteners shall utilize metal stress distribution plates, with screws of sufficient length to penetrate each type of roof deck the minimum required by Factory Mutual.
 - a. Steel Decks: InsulFast #12 roofing fasteners as provided by Carlisle Syntec. Minimum deck penetration is 3/4 inch for steel decks.
 - b. Fastener Plates: Shall be galvalume-coated steel insulation plates, as provided by Carlisle Syntec, with a diameter of 3 inches, 0.20 nominal thickness and a galvalume finish.
 3. Insulation Adhesive: A two-component, spray applied or extruded low rise foam adhesive designed to adhere insulation to insulation.
 - a. Manufacturer/Product: Carlisle Syntec Flexible FAST Adhesive or product recommended by insulation and roof membrane manufacturer.
 - 1) VOC Content: 0 g/L.
 - b. Provide appropriate adhesive catalyst where temperatures are below 50 degrees F as recommended by roof membrane manufacturer.

2.04 COVERBOARD

- A. Minimum 1/2 inch DensDeck Prime with Eonic Technology Roof Board, 4 feet by 4 feet

sheets, as manufactured by Georgia-Pacific.

1. Water Absorption per ASTM C473: Less than 5 percent of weight.
 2. Surface Water Absorption per ASTM C473: Nominal 1.0 grams.
- B. Coverboard Adhesive: A two-component, spray applied or extruded low rise foam adhesive designed to adhere coverboard to insulation.
1. Manufacturer/Product: Carlisle Syntec Flexible FAST Adhesive or product recommended by insulation manufacturer, coverboard manufacturer and roof membrane manufacturer.
 - a. Provide appropriate adhesive catalyst where temperatures are below 50 degrees F as recommended by roofing manufacturer.
 - b. VOC Content: 0 g/L.

2.05 FLASHINGS

A. TPO (Sure-Weld) Related Products

1. Sure-Weld non-reinforced flashing: 0.060 TPO flashing to be used for inside/outside corners and field fabricated pipe flashings where the use of pre-molded or pre-fabricated accessories is not feasible.
 - a. Size: 12 inch and 24 inch wide by 50 foot long rolls.
 - b. Color: Match roof membrane.
2. Sure-Weld reinforced flashing: Provide 0.060 by 9" wide by 50' long Sure-Weld reinforced membrane for overlaying fasteners and fastening plates.
3. Sure-Weld Pressure-Sensitive Cover Strip: A nominal 40-mil thick non-reinforced TPO membrane laminated to nominal 35-mil thick cured synthetic rubber pressure-sensitive adhesive used in conjunction with TPO Primer to strip in flat metal flanges (i.e., drip edges or rows of fasteners and plates).
 - a. Size: 6 inch wide by 100 foot long.
 - b. Color: Match roof membrane.
4. Sure-Weld TPO T-Joint Covers: A 60-mil thick injection molded TPO flashing formed into a 4.5 inch diameter circle used to seal step-offs at splice intersections.
 - a. Installation: Mandatory.
 - b. Color: Match roof membrane.
5. Pre-Molded Accessories:
 - a. Inside Corners: A pre-molded 60-mil thick corner flashing for inside corners. Color to match roof membrane.
 - b. Outside Corners: A one-piece 60-mil thick injection molded corner flashing used for flashing outside corners. Color to match roof membrane.

- c. TPO Curb Wrap Corners: Fabricated flashings made of 60-mil thick reinforced Sure-Weld membrane.
 - 1) Size: Each corner shall be fabricated with a 6 inch wide base flange and a 12 inch overall height. Size as required to fit curb. Each curb requires four corners.
 - d. Pipe Flashings: A pre-molded pipe flashing used for pipe penetrations. Color to match roof membrane.
 - 1) Sizes: As required to fit ¾ inch to 8 inch diameter pipes. Provide stainless steel clamping ring.
 - e. Split Pipe Seals: A prefabricated flashing consisting of 60-mil thick reinforced Sure-Weld Membrane for pipes 1 inch to 6 inch in diameter. A split (cut) and overlapped tab are incorporated to allow the pipe seal to be opened and wrapped around the pipe when it is not possible to pull a standard pipe flashing over a round penetration.
 - f. TPO Square Tubing Wraps: Fabricated flashings made of 60-mil thick reinforced Sure-Weld membrane for square tubing. A split (cut) and overlap tab are incorporated into these parts to allow the seals to be opened and wrapped around a square penetration.
 - 1) Sizes to fit: 3 inch, 4 inch, 5 inch and 6 inch square tubing.
 - g. Molded TPO Sealant Pocket: A pre-fabricated, interlocking, 2-piece, injection molded, flexible pocket with a rigid polypropylene vertical wall and pre-formed deck flanges. Pockets can be adjusted from 11.5 inches to 7.5 inches in length by 6 inches in width. Used in conjunction with White One-Part Pourable Sealer. Color, white.
 - h. Pre-fabricated Sealant Pocket: A two-piece, pre-fabricated sealant pocket made of reinforced 60-mil TPO membrane and coated metal to form a rigid, oversized sealant pocket with a weldable horizontal deck flange.
 - i. Sealant Pocket Extension Legs: Designed for use with the TPO Molded Sealant Pocket and the Pre-Fabricated Sealant Pocket to extend the length in increments of 10 inches. Fabricated from 60-mil thick reinforced TPO membrane and TPO coated metal. Color, white.
- B. Liquid Flashing: Manufacturers standard liquid flashing resin a two-component polyurethane-based resin used with liquid flashing fleece that is compatible with TPO roof membrane.

- 1. VOC Content: 2 g/L.

2.06 ADHESIVES AND CLEANERS

- A. Low-VOC Bonding Adhesive: A high-strength, solvent-based contact adhesive for bonding Sure-Weld membrane to various surfaces. The adhesive is applied to both the membrane and the substrate at a coverage rate of approximately 60 square feet per gallon per finished surface (includes coverage on both surfaces).
 - 1. VOC Less than 250 g/L. Complies with Max VOC allowed 250 g/L.
- B. Low-VOC Cut-Edge Sealant: A clear colored sealant used to seal cut edges of reinforced

Sure-Weld membrane. A coverage rate of approximately 225 - 275 linear feet per squeeze bottle can be achieved when a 1/8" diameter bead is applied.

1. VOC Content 235 g/L. Complies with Max VOC allowed 450 g/L.
- C. Water Cut-Off Mastic: Used as a mastic to prevent moisture migration at drains, compression terminations and beneath conventional metal edging (at a coverage rate of approximately 10' per tube or 100' per gallon).
1. VOC Content 250 g/L. Complies with Max VOC allowed 250 g/L.
- D. Universal Single-Ply Sealant: A 100% solids, solvent free, voc free, one part polyether sealant that provides a weather tight seal to a variety of building materials. It is white in color and is used for general caulking such as above termination bars and metal counter flashings and at scuppers.
1. VOC Content 22 g/L. Complies with Max VOC allowed 450 g/L.
- E. Thermoplastic One-Part Pourable Sealer: A one-part, moisture curing, elastomeric polyether sealant used to fill TPO Molded Pourable Sealant Pockets. Packaged in 4, 2-liter foil pouches inside a reusable plastic bucket. 1 pouch will fill 2 TPO Molded Pourable Sealant Pockets.
1. VOC Content less than 25 g/L. Complies with Max VOC allowed 450 g/L.
- F. Weathered Membrane Cleaner: Used to prepare membrane for heat welding that has been exposed to the elements or to remove general construction dirt at an approximate coverage rate of 400 square feet per gallon (one surface).
- G. TPO Low VOC Primer:: A solvent-based, low solids primer used to prepare the surface of Sure-Weld Membrane prior to application of Pressure-Sensitive Coverstrip and TPO Pressure-Sensitive RUSS. This low VOC product is ideal for use in states where environmental issues are a concern.
1. VOC Content less than 250 g/L. Complies with Max VOC allowed for all other sealant primers 750 g/L.

2.07 FASTENERS AND PLATES

- A. HP-X Fasteners: A heavy-duty #15 threaded fastener with a #3 Phillips drive used for membrane or insulation securement into steel, wood plank or minimum 15/32 inch thick plywood when increased pullout resistance is desired.
- B. HP-Xtra Fastener: An oversized diameter (.315) steel threaded fastener with a #3 Phillips drive used in conjunction with Piranha Xtra Plates for membrane securement into steel or wood decks.
- C. Pre-Assembled ASAP Fasteners: A pre-assembled 3-inch diameter Plastic Plate and # 12 threaded fastener with a #3 drive used for insulation attachment into steel or wood decks. Installed using OMG Fastening Tools.
- D. InsulFast Fasteners: A threaded #12 fastener with #3 Phillips drive used for insulation

attachment into steel or wood decks.

- E. HP Term Bar Nail-Ins: A 1-1/4 inch long expansion anchor with a zinc-plated steel drive pin used for fastening the Carlisle Termination Bar or Seam Fastening Plates to concrete, brick, or block walls.
- F. Piranha Plates: A 2-3/8 inch diameter metal barbed fastening plate used with Carlisle HP-X or HP-14-10 Fasteners for membrane securement. This plate can be used for insulation securement.
- G. Piranha Xtra Plates: A 2-3/8" diameter metal barbed fastening plate with an oversized hole for use with Carlisle HP-Xtra Fasteners for membrane securement.
- H. Insulation Fastening Plates: a nominal 3 inch diameter plastic or metal plate used for insulation attachment.
- I. Sure-Weld Pressure-Sensitive RUSS (Reinforced Universal Securement Strip): A 6-inch wide, nominal 60-mil thick reinforced TPO membrane with 3-inch wide Pressure Sensitive Tape laminated along one edge. The 6-inch wide Pressure-Sensitive RUSS is used horizontally at the base of walls, curbs, etc., in conjunction with 2-inch diameter Seam Fastening Plates below the TPO deck membrane for additional membrane securement.
 - 1. 6-inch wide Pressure-Sensitive RUSS is used horizontally or vertically at the base of walls, curbs, etc., in conjunction with PiranhaFastening Plates below the TPO deck membrane for additional membrane securement.
 - 2. 10-inch wide Pressure-Sensitive RUSS is for perimeter membrane securement.

2.08 WALKWAYS

- A. Protective surfacing for roof traffic shall be Sure-Weld TPO Walkway Rolls installed per manufacturer's requirements.

2.09 METAL ACCESSORIES

- A. Coated metal: 24 gauge galvanized sheet coated with a layer of 40 mil non-reinforced flashing. Sheet cut to size shown on drawings.
 - 1. Use: Separation flashing where single ply roof membrane ties into fluid applied membrane air barrier system.

PART 3 EXECUTION

3.01 GENERAL

- A. Comply with the manufacturer's published instructions for the installation of the membrane roofing system as required to meet warranty and wind storm classification requirements including proper substrate preparation, job site considerations and weather restrictions.
- B. Position sheets to accommodate contours of the roof deck and shingle splices to avoid bucking water.

3.02 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and Project Conditions.
- B. Examine substrates, areas, and conditions under which roofing will be applied, with Installer present, for compliance with requirements.
- C. Verify that roof openings and penetrations are in place and set and braced and that roof drains are properly clamped into position.
- D. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at roof penetrations and terminations and match the thicknesses of insulation required.
- E. Verify that flatness and fastening of metal roof decks comply with installation tolerances specified in Section 05 31 23 – Steel Roof Decking.
- F. Verify that deck is securely fastened with no projecting fasteners and with no adjacent units in excess of 1/16 inch (1.5 mm) out of plane.
- G. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.03 INSULATION STOPS/NAILERS

- A. Install insulation stops/nailers at all open eaves and edges, where wood curbs are installed and where shown on Drawings.
 - 1. Insulation stops/nailers shall be treated wood blocks the same thickness as the roof insulation and shall be a minimum of 5 1/2 inches wide, unless otherwise noted on the Drawings.
- B. Secure wood nailers to roof structure in accordance with the current edition of ANSI/SPRI ES-1 and FM 1-49.
 - 1. Bottom nailers: Where the nailers are secured to the metal roof deck, install the bottom nailer to the metal deck with two rows of No. 10 steel screws spaced at 12 inches o.c. Place a 5/8 inch outside diameter steel washer under the head of each screw. At corner regions, space screws at 6 inches o.c. Each wood nailer shall have at least two fasteners. A fastener shall be located approximately 4 inches but not less than 3 inches from each end.
 - a. Screws and washers installed in preservative treated wood shall be:
 - 1) Stainless steel type 304 or 316;
 - 2) Proprietary anti-corrosion coatings which have been recommended by manufacturer for use with preservative-treated materials.
 - 2. Bottom nailers: Where the nailers are secured to steel angles/plates, install the bottom nailer to the steel angle/plate with hot-dipped galvanized steel bolts or hot-dipped galvanized threaded studs welded to angle/plate hot dip galvanized per ASTM A513. Bolts/studs shall be 1/2 inch diameter with nuts and washers spaced at 48 inches o.c. At corner regions, place bolts/studs at 24 inches o.c. Each bolt shall have two washers, one under each bolt head and one under each nut. Each

stud shall have one washer under each nut. For wood nailers wider than 5 1/2 inches, bolts/studs shall be staggered. Each wood nailer shall have at least two bolts/studs. A bolt/stud shall be located 4 inches from each end of wood nailer.

3. Top nailers: Secure top nailers to bottom nailer with annular ring shank nails. Nails shall be long enough to penetrate 1 1/4 inches into the bottom nailer and each additional nailer layer. Provide two rows staggered spaced at 12 inches o.c. maximum. Spacing shall not exceed 6 inches, at corner regions. Withdrawal resistance should be 200 lb per nail.
 - a. Nails installed in preservative treated wood shall be:
 - 1) Stainless steel type 304 or 316;
 - 2) Proprietary anti-corrosion coatings which have been recommended by manufacturer for use with preservative-treated materials.

3.04 INSULATION

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with roofing system manufacturer's written instructions for installing roofing insulation.
- C. First Layer Insulation Application:
 1. Position 2.2 inch thick boards to ensure board edges bear on top flange of metal deck, minimum 1 inch. Cut and realign boards which do not bear sufficiently on top flange of metal deck.
 2. Install insulation with long joints of insulation in continuous straight lines with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.
 - a. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.
 3. Fasten first layer of insulation with screw and plates to metal deck. Ensure fasteners engage top of deck flute and penetrate deck a minimum of 3/4 inches.
 4. Ensure field fastening pattern complies with the wind uplift loads per ASCE/SEI 7 requirements, and the design pressures per Quality Assurance Article and the insulation and roofing system manufacturer's written instructions.
 5. Increase number of fasteners at corners, roof perimeters, and penetrations to meet the wind uplift requirements based on ASCE/SEI 7 and the design pressures per Quality Assurance Article.
 6. Ensure screws engage deck properly. Remove unengaged screws and reposition new screws to engage deck.
- D. Second Layer Insulation Application:

1. Set 2.2 inch thick second layer in two-component low rise-rise polyurethane foam adhesive.
 - a. Low-rise foam pattern shall be in accordance with specified wind uplift requirements.
 2. Stagger joints, minimum 6 inches, in both directions from first layer insulation. Remove and replace insulation with improper staggering of joints.
 3. Set loose, cut boards at overnight tie-ins to provide uninterrupted staggering of insulation joints, upon resumption of work.
- E. Tapered Installation: Install tapered insulation under area of roofing to conform to slopes indicated and to Shop Drawings so as to provide uniform positive drainage. The tapered insulation shall be mechanically fastened with screws and plates to metal deck using materials approved by the manufacturer, meeting the wind rating requirements specified.
1. Install cricket installation at edge of drain sumps.
 2. Establish straight, uniform cricket valley position over second layer roof insulation.
 3. Cricket valley slopes shall be a minimum of 3:1.
 4. Cricket surface slopes shall be a minimum of twice the slope of the roof.

3.05 COVERBOARD

- A. Install coverboard in accordance with manufacturer's instructions.
- B. Install coverboard over the entire surface of roof insulation. Only apply as much coverboard that can be covered in the same day by the roof membrane.
 1. Coverboard panels shall be kept dry before, during and after installation.
- C. Secure coverboard to insulation with two-component low- rise polyurethane foam adhesive in accordance with manufacturer's instructions and wind-uplift requirements.

3.06 MEMBRANE PLACEMENT AND ATTACHMENT

- A. Position Sure-Weld membrane over the acceptable substrate. Fold membrane sheet back onto itself so half the underside of the membrane is exposed.
- B. Apply Bonding Adhesive in accordance with the manufacturer's published instructions, to the exposed underside of the membrane and the corresponding substrate area. Do not apply Bonding Adhesive along the splice edge of the membrane to be hot air welded over the adjoining sheet. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.
 1. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded section of the membrane sheet immediately after rolling the membrane into the adhesive with a soft bristle push broom to achieve maximum contact.

2. Fold back the unbonded half of the sheet and repeat the bonding procedures.
- C. Position adjoining sheets to allow a minimum overlap of 2 inches to provide a minimum 1-1/2 inch hot air weld.
- D. Continue to install adjoining membrane sheets in the same manner, overlapping edges a minimum of 2 inches and complete the bonding procedures as stated previously.

3.07 MEMBRANE HOT AIR WELDING PROCEDURES

- A. Hot air weld the Sure-Weld membrane using an Automatic Hot Air Welding Machine or Hot Air Hand Welder in accordance with the manufacturer's specifications. At all splice intersections, roll the seam with a silicone roller immediately after welder crossed the membrane step-off to ensure a continuous hot air welded seam.
 1. Note: All splice intersections shall be overlaid with Sure-Weld T-joint covers or non-reinforced flashing.
- B. Probe all seams once the hot air welds have thoroughly cooled (approximately 30 minutes).
- C. Repair all seam deficiencies the same day they are discovered.
- D. Apply Cut Edge Sealant on all cut edges of reinforced membrane (where the scrim reinforcement is exposed) after seam probing is complete. Cut Edge Sealant is not required on vertical splices.

3.08 FLASHING

- A. Flashing of parapets, curbs, expansion joints and other parts of the roof must be performed using Sure-Weld reinforced membrane. Sure-Weld non-reinforced membrane can be used for flashing pipe penetrations, Sealant Pockets, and scuppers, as well as inside and outside corners, when the use of prefabricated accessories is not feasible.
- B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.
- C. Liquid flashing: Use liquid flashing to flash oddly shaped penetrations.

3.09 SEPARATION FLASHING

- A. Install coated metal flashing where single ply roof membrane is tied into the fluid applied air barrier membrane.

3.10 WALKWAYS

- A. Install walkways at all traffic concentration points (such as roof access doors, rooftop ladders, etc.) and all locations as identified on the specifier's drawing.
- B. Hot air weld walkway material to the membrane.

3.11 PROTECTION AROUND GREASE FANS and HVAC EQUIPMENT

- A. Around the perimeter of roof mounted grease fans install an additional layer of 80 mil TPO for a horizontal distance of ten feet around each grease fan.
- B. Around the perimeter of roof mounted HVAC units install an additional layer of 80 mil TPO for a horizontal distance of ten feet around each HVAC unit.

3.12 DAILY SEAL

- A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal must be performed to temporarily close the membrane to prevent water infiltration.
- B. Complete an acceptable membrane seal in accordance with the manufacturer's requirements.

3.13 CLEAN-UP

- A. Perform daily clean up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris must be disposed of in a legally acceptable manner.
- B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

END OF SECTION

SECTION 07 62 00 – SHEET METAL FLASHINGS AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Scuppers
- B. Exposed Trim
- C. Gravel-Stop Fascia
- D. Copings
- E. Flashing
 - 1. Receivers
 - 2. Counterflashing

1.02 RELATED WORK

- A. Section 04 20 00 – Unit Masonry: Through Wall Flashing in Masonry.
- B. Section 04 20 19 – Veneer Unit Masonry: Through Wall Flashing in Masonry.
- C. Section 04 43 13 – Mortar Placed Stone Veneer: Through Wall Flashing in Masonry.
- D. Section 06 10 53 – Miscellaneous Carpentry: Securing metal flashings to preservative treated lumber/plywood.
- E. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Sealing materials with transition membrane
- F. Section 07 54 23 – Thermoplastic Polyolefin Roofing: Sheet metal and underlayment materials.
- G. Section 07 72 33 – Roof Hatches: Metal Curbs.
- H. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment: Roof Curbs for Mechanical Equipment.
- I. Section 26 05 29 – Hangers and Supports for Electrical Systems: Roof Curbs for Electrical Equipment.

1.03 REFERENCES

- A. SMACNA – Architectural Sheet Metal Manual, Current Edition.
- B. ASTM A240 – Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- C. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (galvanized) or Zinc-

Iron Alloy-Coated (Galvannealed) by Hot Dip Process.

- D. ASTM A792 – Standard Specification for Steel Sheet 55%, Aluminum-Zinc Alloy-Coated By the Hot-Dip Process, General Requirements.
- E. ASTM B32 – Solder Metal.
- F. ASTM B749 – Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products.
- G. ASTM AFS 0-F-506 – Flux, Soldering, Paste, and Liquid.
- H. National Roofing Contractors Association, Roofing and Waterproofing Manual Current Edition.
- I. ANSI/SPRI ES-1 Current Edition American National Standard Wind Design Standard for Edge Systems Used With Low Slope Roofing Systems.
- J. ASCE/SEI 7 Standard – Current Edition. American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Submit four samples, 4 inches x 4 inches, illustrating metal finish color prior to fabrication and installation.
- D. Product Data: Submit data on manufactured components metal types, finishes and characteristics.
- E. Test Results:
 - 1. Provide pull-off test results for edge flashings in accordance with current edition of ANSI/SPRI ES-1, SPRI test method RE-2.
 - a. Test results shall meet or exceed design wind pressures as calculated to RE-2.
 - 2. Provide pull-off test results for copings in accordance with current edition of ANSI/SPRI ES-1, SPRI test method RE-3.
 - a. Test results shall meet or exceed horizontal and vertical design wind pressures as calculated according to RE-3.
- F. Submit sample workmanship and material warranties.
- G. Submit sealant literature.
- H. Sealants

1. The General Contractor shall provide to sealant manufacturers, samples of all substrates which are in contact with sealant, regardless of whether adhesion must be achieved.
 2. For substrates which must support adhesion, submit to the Architect, for record only, sealant manufacturer's reports of adhesion tests conducted in accordance with ASTM C794.
- I. Submit fasteners.
 - J. Provide certification that sheet metal fabricator is an authorized fabricator in accordance with NRCA's ITS Certification. Provide evidence that the sheet metal edge flashings and copings have been approved and listed by NRCA and Intertek Testing Services (ITS).

1.05 DESIGN REQUIREMENTS

- A. Design and size edge systems and copings in accordance with current edition of ANSI/SPRI ES-1.
 1. Wind Speed: As indicated on Structural Drawings.
 2. Exposure: As indicated on Structural Drawings.
 3. Importance Factor: As indicated on Structural Drawings.

1.06 QUALIFICATIONS

- A. Fabricator and Installer: Company specializing in sheet metal work with minimum five years of documented experience.
- B. The sheet metal edge flashings and copings shall be listed by NRCA and tested by Intertek Testing Services (ITS). Sheet metal fabricator shall be NRCA ITS Certified.
 1. The metal edge securement including the coping, except gutter, shall be installed as tested in accordance with the most current version of the ANSI/SPRI ES-1, American National Standard for Edge Systems Used with Low-Slope Roofing Systems.
 2. Copings: Copings shall be tested per the current edition of ANSI/SPRI ES-1, Test RE-3 for Copings. The coping system shall be tested simultaneously on horizontal and vertical surfaces and shall exceed horizontal and vertical design wind pressure as calculated in accord with the ANSI/SPRI ES-1 current edition, Test RE-3.
 3. Edge Metal: The vertical face of edge metal flashing shall be tested per the current edition of ANSI/SPRI ES-1, Test RE-2 for edge metal. Test results shall meet or exceed design wind pressures as calculated in accord with ANSI/SPRI ES-1 current edition, RE-2.
 4. Refer to Structural Drawing for design loads.

1.07 WARRANTY

- A. Provide a two-year workmanship warranty.

- B. Steel Warranty:
 - 1. Galvalume material shall have a 20-year guarantee against failure due to corrosion, rupture or perforation.
- C. Finish Warranty:
 - 1. Furnish manufacturer's standard 20-year warranty stating architectural fluoropolymer finish will perform as follows:
 - a. Weathering Tests (Florida Exposure, 10 years):
 - 1) Color Retention: Free of fading or color change in excess of 5 delta E Units (Hunter) of color change as calculated in accordance with ASTM D2244.
 - 2) Chalk Resistance: Chalking shall be no more than that represented by a No. 8 rating based on ASTM D4214, test method A, after test site exposure.
 - 3) Gloss Retention: Not less than 50% loss of gloss after exposure test.
 - 4) Resistance to Erosion: Less than 10% film loss after the exposure test.
 - b. Flexibility: No evidence of cracking when viewed with the unaided eye, and no loss of adhesion to the point of metal rupture, using a 180-degree bend on a 1/8-inch mandrel per ASTM D522.
 - c. T Bend: Perform to a grade "1T" per ASTM D4145.
 - d. Film Adhesion:
 - 1) No removal of film under the tape within or outside of the cross-hatched area or blistering anywhere on the test specimen, test in accordance with NCCA 4.2.10.
 - 2) No coating removed by scotch tape on tested area per ASTM D3359.
 - e. Reverse and Direct Impact Resistance:
 - 1) Hot-Dipped Galvanized (HDG), ASTM A525, G90, Minimum Steel or Zinc-Aluminum Coated Steel Such as Galvalume: No cracking, no removal of film from substrate, using 3x metal thickness in inch lbs. and 5/8-inch ball indenter (Gardner Impact Test) when tested in accordance with ASTM D2749.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
- B. Deliver, store, and protect products according to manufacturer's recommendations.
- C. Stack pre-formed metal to prevent twisting, bending or abrasion and to provide ventilation.
- D. Slope metal sheets to ensure drainage.

- E. Prevent contact with materials during storage which may cause discoloration or staining.
- F. Do not install material which becomes damaged during storage and handling.

1.09 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project.
- B. Coordinate with related Work and ensure timely installation of Work of this Section.

1.10 PRE-INSTALLATION MEETING

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Convene 4 weeks prior to commencing work of this Section.
- C. Review installation procedures and coordination required with related Work.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Stainless Steel: ASTM A240; Type 302/304, dead soft fully annealed, 26 gauge, smooth, milled rolled, Number 2D finish.
- B. Galvanized Sheet Metal: ASTM A653, G90 zinc coating, structural sheet steel, various gauges.
- C. Pre-Finished Galvalume: ASTM A792-AZ50, Grade 40, structural quality, various gauges.
 - 1. Finish: Minimum two-coat fluoropolymer coating with minimum 70% polyvinylidene fluoride resin (Kynar 500, Kynar 500 VLD or Hylar 5000) by weight.
 - a. Primer: 0.25 to 0.35 mils thick.
 - b. Color top coat: 0.7 to 0.9 mils thick.
 - 2. Manufacturer: The Valspar Corporation.
 - 3. Color: As selected from manufacturer's standard color.

2.02 ACCESSORIES

- A. Fasteners: **NOTE:** All fasteners shall be corrosion resistant. All fasteners used to connect materials to preservative treated lumber and plywood shall be as appropriate for use with the specified wood treatments and with the roof/sheet metal materials being fastened. Select appropriate fasteners as required to prevent galvanic corrosion with other materials.
 - 1. Roofing Nails: Threaded, or ring-shank, minimum 3/8-inch head, in lengths to match application.
 - a. Finish:

- 1) Stainless steel Type 304 or 316.
 - 2) Fasteners with proprietary anti-corrosion coatings may be submitted for use with treated wood. When submitted, the fastener manufacturer shall furnish specific information regarding the performance of their products in the specified treated wood and any precautions or special instructions that may be applicable.
2. Wood Screws: #14 hex head or pan head, with integral, steel washer and minimum 5/8-inch neoprene or EPDM washer; prefinished heads and washers where exposed to view.
- a. Finish:
- 1) Stainless steel Type 304 or 316.
 - 2) Fasteners with proprietary anti-corrosion coatings may be submitted for use with treated wood. When submitted, the fastener manufacturer shall furnish specific information regarding the performance of their products in the specified treated wood and any precautions or special instructions that may be applicable.
3. Sheet Metal Screws: #14; round or pan head, prefinished heads and rubber, neoprene or EPDM washers. Provide stainless steel for use with stainless steel flashing.
- a. Finish:
- 1) Hot-dipped galvanized per ASTM A153.
 - 2) Stainless steel Type 304 or 316.
 - 3) Fasteners with proprietary anti-corrosion coatings may be submitted for use with treated wood. When submitted, the fastener manufacturer shall furnish specific information regarding the performance of their products in the specified treated wood and any precautions or special instructions that may be applicable.
4. Fastener lengths as required to penetrate:
- a. Minimum 1 1/4 inch, or through wood receiving members.
 - b. 1/2 inch through sheet metal and steel receiving members.
- B. Solder: ASTM B32 – 50/50 type.
- C. Flux: FS 0-F-506.
- D. Primer: As recommended by single ply (TPO) roof manufacturer.
- E. Sealant/Tape:
1. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. NOTE: Sealants in contact with single ply (TPO)

membrane and metal flashing shall be compatible with single ply (TPO) membrane. Refer to Section 07 54 23 Thermoplastic Polyolefin Roofing for approved sealants.

- a. BASF Building Systems; MasterSeal NP 150.
 - 1) VOC Content: 14 g/L.
 - b. Kemper System: GreatSeal PE-150 multipurpose sealant.
 - 1) VOC Content: 18.26 g/L.
 - c. Substitutions: Comply with the requirements of this section and Division 1 requirements and the following:
 - 1) Sealant shall comply with ASTM C920, Type S, Grade NS, Class 25 or higher. Use NT, T, M, G, A and O.
2. Primers: Prime the following surfaces with primer recommended by joint sealant manufacturer:
 - a. Fluorocarbon (Kynar) coatings.
 - b. Galvanized steel.
 - c. Stainless steel.
 3. Verify adhesion of sealant to each metal and coating specified in accordance with ASTM C794.
 4. Sealant Tape: 100 percent solids, high grade, butyl, size to fit application.
 5. Coordinate sealants and sealant tapes with roof membrane specified in:
 - a. Section 07 54 23 – Thermoplastic Polyolefin Roofing for compatibility.

2.03 FABRICATION

- A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" or NRCA Construction Details that apply to the design, dimensions, metal and other characteristics of the item indicated.
- B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Form exposed sheet metal Work that is without oil canning, buckling, tool marks and defects, and that is true to line and levels indicated, true to shape, accurate in size, square with exposed edges folded back to form hems.
- D. Fabricate concealed cleats from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.
 1. Size: As recommended by NRCA for application.

2. Cleat gauge shall be one gauge heavier than material being fastened.
 3. All cleats shall be continuous with lengths not to exceed 12 feet. Allow a 1/4-inch gap between pieces. Joints in cleats shall not coincide with joints in metal.
- E. Form pieces in 10-foot sections.
- F. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- G. Fabricate corners, intersections and terminations of "running" flashing as fixed components, separate from other lengths of flashing. Fabricate such components with maximum 18-inch legs.
- H. Form joints in running flashings to accommodate thermal movement equally throughout all joints.
- I. Form material with standing seams, flat lock seams, except where otherwise indicated.
- J. Movement Joints:
1. At moving joints, use sealed lapped, or bayonet-type joints. Where lapped or bayonet-type joint provision in work cannot be used or will not be weatherproof and waterproof, form moving joints of interlocking hooked seams, not less than 1 inch deep, filled with sealant (concealed within joint).
- K. Fabricate vertical faces with bottom edge formed outward 3/4 inch, maximum 30-degree brake, and hemmed to form a drip.
- L. Fabricate accessories in profile and size to suit gutters and downspouts.
1. Anchorage Devices: In accordance with SMACNA requirements.
- M. Obtain approval to adjust dimensions and configurations of sheet metal flashings, within acceptable limits, to allow more effective yield of material or to facilitate fabrication in sheet metal brake. Ensure adjustments comply with design intent.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that related Work has progressed to the appropriate stage.
- B. Verify suitability of receiving surfaces.

3.02 PREPARATION

- A. Field-measure site conditions prior to fabricating work. Note variances; adjust dimensions to accommodate site conditions.
- B. Pre-prime top and bottom surfaces of metal flanges which are built into single ply (TPO) membrane roof, except where field soldered.

- C. Separate metal from noncompatible metal, corrosive substrates or preservative-treated materials by permanent separation material as recommended by single ply (TPO_ roofing manufacturer.
- D. Metal Flashings
 - 1. Remove scale, rust, loose or inappropriate coatings, oils and protective films from metal a bright surface.
 - 2. Prime the following surfaces with a primer recommended by joint manufacturer:
 - a. Fluorocarbon (Kynar) coatings.
 - b. Galvanized, galvalume steel.
 - c. Stainless steel.
- E. Penetrations within manufactured roof penetrations
 - 1. Thoroughly clean and remove all loose roof cement, mastics, coatings, scaled rust and caulking from the penetration.
- F. Priming
 - 1. Where priming metal flashings is required for proper adhesion, comply with the following:
 - a. Apply primer at full strength by wiping or brushing. Apply primer to a light, uniform coating. Do not apply or allow primer onto exposed face of substrate.
 - b. Prime all joints in gutters.
 - c. Allow primer to dry in accordance with manufacturer's instructions.
 - d. Primer shall be compatible with single ply roof membrane specified in:
 - 1) Section 07 54 23 Thermoplastic Polyolefin Roofing.

3.03 SOLDERING

- A. Solder only fixed components such as corners, intersections, termination, skirts, collars and one-piece flashings made of galvanized sheet steel and stainless steel.
- B. Pre-tin both sides of edges to be soldered using flux and solder to full-anticipated width of joint.
- C. Join sub-components together before soldering. For flat seams, and whenever possible, form flat-lock seams binding sheets tightly. Where flat-lock seams are impractical, provide tabs, partially interlocked if possible, and join with pop-rivets at 1 inch on center.
- D. Do not solder over nail heads.
- E. Apply flux to surface of joint, and solder slowly with well-heated irons. Heat sheets as necessary to sweat solder to full width of seam, or minimum 3/4 inch. Ensure an even flow of solder without excess build-up.
- F. Solder joints in a horizontal position whenever possible. When soldering on slopes steeper than 45 degrees, apply a second bead, neatly laced.

- G. Neutralize flux from surfaces immediately after soldering, use cloth saturated with 10% solution of soda and water, and wipe using separate cloth and clean water.

3.04 JOINTING

- A. Form joints in running flashings to accommodate thermal movement equally throughout all joints.
- B. Provide "slip"-type joints each side of soldered or joined components, except where total length of intersecting lengths is less than 5 feet.
- C. Provide joints aligned with expansion or control joints in walls. Overlap, notch and loosely interlock adjoining sections at lower hem. Fasten only one side of joint to wall.
- D. Form rigid, fixed joints only when constructing fixed components. Provide minimum 3/4-inch tabs, interlocked where possible. Join sections with tabs concealed.
- E. Solder fixed joints in galvanized and stainless-steel metal. Seal laps and rivet 2 inches on center fixed joints in prefinished metal.
- F. Flashing Receivers:
 - 1. Form butt joint, leaving 1/2-inch space.
 - 2. Set 4-inch cover plate in double, side-by-side bead of sealant each side of joint (4 beads total). Hook lower edge of plate minimum 1/2 inch into pocket.
 - 3. Fasten plate only at center without engaging either flashing length. Provide slight kick-down all sides of plate.
 - 4. Tab inside and outside corners, seal between tabs with sealant, and rivet 1 inch on center.
- G. Counterflashing:
 - 1. Form minimum 4-inch lap joint. Apply single bead of sealant concealed inside lap. Notch and interlock lower hem allowing for 1/4-inch movement. Do not fasten through lap.
 - 2. Tab inside and outside corners, seal between tabs with sealant (or solder corner) and pop-rivet 1 inch on center.
 - 3. Install counterflashing so that a minimum of 4 inches of the roof membrane base flashing is covered. The lower edge of the counterflashing shall be 1 inch minimum above the cant.
- H. Concealed Cleats: Maximum length 12 feet. Leave 1/4-inch space between lengths. Joints in cleat shall not coincide with joints in fascia metal.
- I. Membrane Roofing, Embedded Edge Metal Flashing (Gravel Stop):
 - 1. Form butt joint with 12-inch backer plate and 6-inch cover plate. Backer plate and cover plate shall be formed to the profile of the gravel stop.

2. Set continuous cleat on top of roofing membrane.
3. Set backer plate on top of the roofing membrane hooked over cleat.
4. Roof flange width shall be minimum 3 3/4 inches to 4 1/4 inches maximum, recessed 1/2 inch behind nailer edge.
5. Set each length of edge metal flange onto backer plate and hooked over cleat and embedded into single ply sealant. Leave 1/4-inch clearance between end butts. The edge metal roof flange shall be set on top of the roofing membrane. Fasten the flange to the wood nailers with annular ring or barbed shank 1 1/4 inches long roofing nails spaced at 3 inches o.c. in staggered pattern; rows to be 3/4 inch from the edges of the roof flange.
6. Apply single ply sealant over joint, extending to top of stop and along each length of gravel stop flange approximately 3 3/4 inches.
7. Pre-drill cover plate to receive nails to prevent distortion of metal.
8. On the face, install two beads of single ply sealant from the drip edge to the top of the stop.
9. Hook cover plate at face and embed into single ply sealant.
10. Nail through the opening between the gravel stop sections with two nails.
11. Do not over drive nails, causing displacement of single ply sealant or deformation of plate. Ensure that single ply sealant oozes slightly beyond sides of plate and remove excess.
12. Delay nailing of joint components and edge metal flange until both sides of the joint are sealed and positioned.
13. Corners shall be mitered, lapped, sealed and riveted 1-inch o.c.

J. Copings:

1. Copings shall be formed as detailed.
2. Copings shall slope to the roof side a minimum of 1/4 inch per foot.
3. A layer of single ply (TPO) roof membrane shall be installed over the top and vertical edges of the wood nailer.
 - a. Where membrane comes in contact with fluid-applied membrane air barrier, Section 07 27 26 Fluid-Applied Membrane Air Barrier, verify membrane is compatible with air barrier.
4. Form coping cap with a minimum 1-inch-high double-lock standing seam. Lap coping fascia a minimum of 2 inches at each standing seam. Seal lap with a continuous bead of sealant.
5. Copings less than or equal to 12 inches in width: The coping shall be secured to the wood nailer with a continuous cleat on the side away from the roof. On the roof side, fasten the coping to the wood nailer or metal wall panels with screws

and watertight washers, through elongated holes.

6. Copings greater than 12 inches but less than or equal to 24 inches in width: The coping shall be secured to the wood nailer with a continuous cleat on both sides.
7. All seams and joints shall be sealed.
8. Outside and inside corners shall be formed watertight, welded or mitered, seamed and sealed.

3.05 INSTALLATION

- A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.
 1. The edge metal securement including copings, shall be installed as tested in accordance with the most current version of the ANSI/SPRI ES-1, American National Standard for Edge Systems Used with Low-Slope Roofing Systems.
- B. Provide uniform, symmetrical layout of flashing sections, seams, joints, and fasteners.
- C. Roughen surface of prefinished metal flanges which are stripped-in. Ensure single ply strip-in ply bonds to surface.
- D. Ensure proper fit and positioning of flashings. Make adjustments necessary to accommodate variances and imperfections in receiving surfaces.
- E. Install flashings free of warp or distortion, and without stress on fixed components.
- F. Stagger joints between components.
- G. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner.
- H. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with Section 07 54 23 Thermoplastic Polyolefin Roofing and installation of items penetrating roof.

3.06 SCHEDULE

- A. Membrane Roofing, Embedded Edge Metal Flashing (Gravel-Stop) – Note: The metal gauge, fasteners, fastener spacings and installation shall be based on Test RE-2 of the ANSI/SPRI ES-1.
 1. Material: Galvalume Steel
 2. Finish:

- a. Pre-finished.
3. Minimum metal thickness for flatness, exposed face:
 - a. Up to 8 inches: 24 gauge.
 - b. >8 inches to 10 inches: 22 gauge.
 - c. >10 inches to 16 inches: 20 gauge.
4. Fasteners:
 - a. Corrosion resistant, barbed, annular ring or screw shank nail
 - b. Spacing: Staggered 3 inches o.c.
 - c. Length: Minimum 1-1/4 inches penetration into nailer
5. Cleat:
 - a. Material: Galvanized steel with metal flange extension.
 - b. Thickness: Cleat gauge to be one gauge heavier than metal thickness of embedded edge metal flashing.
 - c. Fasteners:
 - 1) Corrosion resistant, barbed, annular ring or screw shank nail.
 - 2) Spacing: 6 inches o.c.
 - 3) Minimum 1 1/4 inches penetration into nailer.
 - 4) Locate fastener near the lower brake.
6. Roof Edge Cover Plate:
 - a. Material: Galvalume steel.
 - b. Finish:
 - 1) Pre-finished..
 - c. Thickness: Match gauge of embedded edge metal flashing
 - d. Fasteners:
 - 1) Corrosion resistant, barbed, annular ring or screw shank nail
 - 2) Spacing: 2 fasteners between opening sections
 - 3) Length: Minimum 1-1/4 inches penetration into nailer
7. Roof Edge Backer Plate:
 - a. Material: Galvanized steel.
 - b. Thickness: Match gauge of embedded edge metal flashing.
 - c. Fasteners:
 - 1) Corrosion resistant, barbed, annular ring or screw shank nail
 - 2) Spacing: Staggered 3 inches o.c.
 - 3) Length: Minimum 1 1/4 penetration into nailer
- B. Copings: Note: The metal gauge, fasteners, fastener spacings and installation shall be based on Test RE-3 of the ANSI/SPRI ES-1.

1. Material: Galvalume steel.
 2. Finish:
 - a. Pre-finished.
 3. Thickness: Widths up to 12 inches = 24 gauge. >12 inches to 18 inches = 22 gauge.
 4. Fasteners:
 - a. Copings up to and equal to 12 inches in width: On roof side, corrosion-resistant screw fasteners with neoprene washers spaced 16 inches o.c. On the opposite side, provide a continuous cleat.
 - b. Copings over 12 inches in width but less than 24 inches: Provide continuous cleats on each side.
 5. Cleat:
 - a. Material: Galvanized steel with metal flange extension.
 - b. Thickness: Cleat gauge to be one gauge heavier than metal thickness of coping.
 - c. Fasteners:
 - 1) Corrosion-resistant, barbed, annular ring or screw shank nail
 - 2) Spacing: 6 inches o.c.
 - 3) Length: Minimum 1-1/4 inches penetration into nailer
 - 4) Locate fasteners near the lower brake.
- C. Pocket Receiver (Built into Masonry)
1. Material: Stainless steel.
 2. Thickness: 26 gauge.
 3. Solder all outside and inside corners.
 4. Fasteners
 - a. Stainless steel screw fasteners.
 - b. Spacing: 8 inches o.c.
- D. Pocket Receiver
1. Material: Galvanized steel.
 2. Thickness: 24 gauge.
 3. Fasteners
 - a. Corrosion resistant screw fasteners.
 - b. Spacing: 8 inches o.c.

4. Solder all outside and inside corners.
- E. Counterflashing (Install in Conjunction with Stainless Steel Pocket Receiver)
1. Material: Stainless steel.
 2. Thickness: 26 gauge.
 3. Fasteners:
 - a. Stainless steel screws with neoprene washers.
 - b. Spacing: 12 inches o.c.
 4. Solder all outside and inside corners.
- F. Counterflashing
1. Material: Galvanized steel.
 2. Thickness: 24 gauge.
 3. Fasteners:
 - a. Corrosion resistant screws with neoprene washers.
 - b. Spacing: 12 inches o.c.
 4. Solder all outside and inside corners.
- G. Scupper:
1. Material: Stainless steel.
 2. Thickness: 26 gauge.
 3. Fasteners:
 - a. Corrosion-resistant screws, barbed, annular ring or screw shank nail.
 - b. Spacing: 3 inches o.c.
 - c. Length: Minimum 1-1/4 inches penetration into nailer.
 4. Hem to scupper cover plate
- H. Scupper Face Plate:
1. Material: Galvalume.
 2. Finish:
 - a. Pre-finished.
 3. Thickness: 24 gauge.

4. Hem to scupper and conductor head.
- I. Penetration Flashing:
 1. Coordinate with Section 07 54 23 Thermoplastic Polyolefin Roofing.
 - J. Fascia Cover:
 1. Material: Galvalume.
 2. Finish:
 - a. Pre-finished.
 3. Thickness: 24 gauge.
 4. Fasteners:
 - a. Corrosion-resistant, barbed, annular ring or screw shank nail.
 - b. Spacing: 12 inches o.c.
 - c. Length: Minimum 1-1/4 inches penetration into nailer.

END OF SECTION

SECTION 07 65 10 – FLEXIBLE FLASHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flexible Flashing for use as through wall flashing and accessories.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 60 00 – Product Requirements: Product substitution procedures
- C. Section 04 20 00 – Unit Masonry: Securing through wall flashing to masonry back up.
- D. Section 04 20 19 – Veneer Unit Masonry: Coordination of through wall flashing with masonry veneer.
- E. Section 04 43 13 – Mortar-Placed Stone Veneer: Coordination of through wall flashing with stone veneer.
- F. Section 04 72 00 – Cast Stone Masonry: Coordination of through wall flashing with cast stone.
- G. Section 06 10 53 – Miscellaneous Carpentry: Corrosion-resistant fasteners used to secure through wall flashing to treated wood nailers.
- H. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Coordination of through wall flashing with fluid-applied air barriers.

1.03 REFERENCES

- A. ASTM International:
 - 1. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless-steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
 - 3. ASTM D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 4. ASTM E84 – Test Methods for Surface Burning Characteristics of Building Materials.
 - 5. ASTM E154 – Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover.
- B. Brick Institute Association (BIA)

1. BIA Technical Notes on Brick Construction No.7 – Water Penetration Resistance – Design and Detailing: Detailing of through wall flashing.
 2. BIA Technical Notes on Brick Construction No. 28B – Brick Veneer/Steel Stud Walls: Detailing through wall flashing.
- C. International Building Code (IBC)
1. 2015 Edition, Section: 1405.4 Flashing: Requirements for flashing.
- 1.04 QUALITY ASSURANCE
- A. Manufacturer: Provide flashing materials by a single manufacturer.
- 1.05 MOCK-UP
- A. Coordinate with the mock up requirements in the following sections:
1. Section 04 20 19 – Veneer Unit Masonry
 2. Section 04 43 13 – Mortar-Placed Stone Veneer
- B. Do not start work until Architect has accepted sample panel.
- C. Use panel as standard of comparison for all masonry work built of the same material.
- D. Do not destroy or move panel until work is completed and accepted by the Owner.
- 1.06 SUBMITTALS
- A. Submit under provisions of Section 01 33 00 – Submittal Procedures. Obtain written acceptance of submittals prior to the purchase of the materials or methods.
- B. Product Data: Provide data for flashing membranes, drip plate, sealants, gasketed fasteners for metal stud, concrete block or concrete surface and accessories as specified. Provide installation and storage instructions for flexible flashing membrane and drip plates. Provide letter from the flexible membrane flashing manufacturer that the flexible flashing membrane and sealants are compatible with specified fluid applied air barrier membrane.
- C. Samples: Provide two 3 inches by 5-inch sample of flashing material.
1. Provide 6-inch-long strip of drip plate.
- D. Certificates: Submit certificates attesting compliance with applicable specifications for grades, types and classes included in these specifications.
- 1.07 QUALIFICATIONS
- A. Installer: Company specializing in performing work of this section with minimum ten years of documented experience.

1.08 PRE-INSTALLATION CONFERENCE

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Coordinate with the following Sections:
 - 1. Section 04 20 00 – Unit Masonry
 - 2. Section 04 20 19 – Veneer Unit Masonry
 - 3. Section 04 43 13 – Mortar Placed Stone Veneer
 - 4. Section 04 72 00 – Cast Stone Masonry

1.09 JOB CONDITIONS

- A. Protection of Flexible Flashing Membrane.
 - 1. Protect flexible flashing membrane from damage. Remove and replace damaged materials prior to installing masonry veneer.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 – Product Requirements.

1.11 WARRANTY

- A. Warrant flexible flashing/drainage system material for life of the wall.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Definitions:
 - 1. Cavity wall flashing: Same as flexible flashing.
 - 2. Foundation sill flashing: Same as flexible flashing.
 - 3. Head and sill flashing: Same as flexible flashing.
 - 4. Through wall flashing: Same as flexible flashing.
 - 5. Flexible flashing: Waterproof material typically used cavity wall construction to contain and assist in the proper water drainage that may penetrate wall system veneer. Other materials may be required to constitute the system.
- B. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide product by one of manufacturers named below. If not named, submit as substitution according to Conditions of the Contract and appropriate Division 01 Sections.

1. Manufacturer: Product
 - a. York Manufacturing, Inc.: York Flash-Vent SS.
 - 1) Alternate: York Manufacturing, Inc Flash Vent SA SS. A self-adhered stainless-steel drainage plane flexible flashing with an Engineered system, with high resistant to damage, composite with a stainless-steel with a butyl co-polymer on one stainless-steel and non-woven drainage fabric laminated to opposing face with non-asphalt adhesive.
 - b. STS Coatings, Inc.: Wall Guardian TWF Stainless-steel.
2. Characteristics
 - a. Engineered composite system made up of a stainless-steel sheet metal core with a polymer fabric adhered to one side and a non-woven drainage fabric laminated on the opposite side. Both the polymer fabric and non-woven drainage mat shall be adhered to the stainless-steel sheet metal core using non-asphalt adhesive.
 - b. Tensile strength, stainless-steel: 100,000 psi average.
 - c. Puncture resistance, stainless-steel: 2,500 psi average.
 - d. Mold resistance: ASTM D3273.
 - e. Fire rating: Class A, per ASTM E84.
 - f. Stainless-steel Sheet Metal Core: Type 304 complying with ASTM A240.
 - g. Fabrics:
 - 1) Polymer Fabric: Laminated to back side of stainless-steel core.
 - 2) Non-Woven Drainage Fabric: Laminated to front face of stainless-steel core.
 - h. Recycled content for stainless-steel: Minimum 60 percent recycled content.
 - i. Size: Manufacturers standard width rolls as follows:
 - 1) Widths: 12, 16, 18, 24, and 36 inches
 - 2) Length: 40 feet
3. Inside and outside corners: 26 gage stainless-steel.
4. Mastic as recommended by flashing manufacturer. Provide a letter from the air barrier manufacturer certifying that the mastic material is compatible with the membrane material.
 - a. York Manufacturing UniverSeal US-100.
 - b. STS Coatings GreatSeal LT-100.
5. Sealants:
 - a. York Manufacturing UniverSeal US-100.
 - b. STS Coatings GreatSeal LT-100.

(Note: Sealant shall be compatible with the fluid applied membrane air barrier.)

6. End Dam: Product may be formed in the field or provide 26 gage preformed stainless-steel.
7. Splice Material: Provide one of the following materials.
 - a. York Manufacturing, York 304 self- adhering stainless-steel material.
 - 1) Widths: 4, 6, 9,12,18,24, and 36 -inch.
 - 2) Length: 20 and 50 feet.
 - b. York Manufacturing Multi-Flash SS stainless-steel fabric flashing.
 - 1) Widths: 12,18,24, and 36- inch
 - 2) Length: 60 feet
8. Termination Bar: One inch, 26 gage stainless-steel termination bar with sealant lip and holes spaced at 8 inches on center. NOTE: Plastic termination bars will not be allowed.
9. Fasteners: Stainless-steel type gasketed fasteners 304 or 316.
10. Drip plate: Hohmann & Barnard DP, 26- gauge Stainless steel drip plate Type 316, 3 ½ inches wide.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify that field conditions are acceptable and are ready to receive work.
- C. Verify items provided by other sections of work are properly sized and located.
- D. Verify built-in items are in proper location, and ready for roughing into masonry work.

3.02 FLEXIBLE MASONRY FLASHINGS

- A. Install through-wall flashing membrane in accordance with manufacturer's printed instructions. Install flashings after the air barrier membrane has been installed.
- B. Extend flashings horizontally at foundation walls, masonry lugs, above all lintels, heads of openings, at bottom of walls, below sills and were shown on Drawings.
 1. At steel lintel angles installed over openings install a continuous stainless steel drip plate.
- C. Vertical Concrete Block Back-up Masonry Surfaces and Vertical Concrete Surfaces:
 1. Surface apply after air/water barrier membrane is installed. Strike a line for the top edge of flashing material. Extend flashing up the face of the wall a minimum of 8 inches. Apply flashing with non-woven wicking fabric surface to outside lining

up flashing top edge with previously struck line. Secure flashing to masonry/concrete surface using a continuous stainless-steel termination bar with stainless-steel fasteners spaced at 8 inches on center. Seal the back of the flashing membrane to the air/water barrier membrane with a continuous bead of polyether sealant using manufacturer's recommended nozzle. Seal the back of the termination bar to the face of the flashing drainage fabric with a continuous bead of polyether sealant using manufacturer's recommended nozzle. Seal the top of the termination bar to the wall with a continuous bead of polyether sealant. Seal heads of all fasteners used to secure termination bar with polyether sealant.

D. Cavity Wall Flashing:

1. Surface apply after air/water barrier membrane is installed. Flashing shall start flush with the outside face of veneer masonry using the factory cut edge, or shall extend 1.5 inches beyond the face of the veneer, extend through the cavity, rising height required to cross cavity and extend up back wall a minimum of 8 inches, as well as the rising height required to extend above the horizontal leg of the steel lintel a minimum of 8 inches. Secure flashing to sheathing surface using a continuous stainless-steel termination bar with stainless-steel fasteners spaced at 8 inches on center. Seal the back of the flashing membrane to the air/water membrane with a continuous bead of polyether sealant using manufacturer's recommended nozzle. Seal the back of the termination bar to the face of the flashing drainage fabric with a continuous bead of polyether sealant using manufacturer's recommended nozzle. Seal the top of the termination bar to the wall with a continuous bead of polyether sealant. Seal heads of all fasteners used to secure termination bar with polyether sealant. At concrete block and concrete surfaces secure flashing per Vertical Concrete Block Back-up Masonry Surfaces and Vertical Concrete Surfaces Paragraph. The horizontal leg of the flashing for exterior veneer shall be laid in multiple beads of continuous polyether sealant per the Horizontal, Concrete and Steel Surfaces Paragraph and topped with a fresh full bed of mortar. The first sealant bead shall be set near the leading edge of the horizontal surface. Do not allow sealant to run beyond the masonry edge when the flashing is pushed into the sealant. At all terminations, turn ends of flashings up at sides a minimum of 2 inches forming a pan. All corners shall be folded or provide preformed end dams, do not cut. Seal with polyether sealant.
 - a. Where flashing is extended 1.5 inches beyond the face of the veneer, trim the flashing flush with the masonry veneer after inspection by agreed upon parties.
 - b. Where self-adhered flashing is used the horizontal leg of the flashing is not required to be set in a continuous bead of polyether sealant.

E. Head and Sill Flashing:

1. Surface apply after air/water barrier membrane is installed. Flashing shall start flush with the outside of the wall or lintel angle using the factory cut edge or shall extend 1.5 inches beyond wall or lintel angle, then carried through or up the wall as per the "Cavity Wall Flashing" paragraph. Secure flashing to sheathing/wood nailer surface using a continuous stainless-steel termination bar with stainless-steel fasteners spaced at 8 inches on center. Seal the back of the flashing membrane to the air/water membrane with a continuous bead of polyether sealant using manufacturer's recommended nozzle. Seal the back of the termination bar to the face of the flashing drainage fabric with a continuous bead

of polyether sealant using manufacturer's recommended nozzle. Seal the top of the termination bar to the wall with a continuous bead of polyether sealant. Seal heads of all fasteners used to secure termination bar with polyether sealant. At lintels flashing shall extend to the first head joint but not less than 6 inches beyond each side of the opening and be turned up minimum 2 inches at the sides (head joint) forming a pan. Where lintels do not bear on masonry, extend the flashing to the end of the lintel and then turn the flashing up a minimum of 2 inches to form a pan. At sills, extend flashing to ends of openings unless otherwise detailed, and turn up minimum 2 inches at sides forming a pan. All corners shall be folded or use preformed end dams, do not cut. Trim flashing flush with the veneer masonry after inspection. Seal with polyether sealant.

- a. At sill flashings where fasteners used to secure masonry/stone veneer anchors penetrate the vertical surface of the through wall flashing membrane seal all penetrations in flashing as follows:
 - 1) Prior to installing the termination bar and masonry veneer anchors, coat the vertical surface of the through wall flashing non-woven drainage fabric with two coats of fluid applied air barrier membrane specified in Section 07 27 26. Install coating using a roller to the limits shown. Do not coat horizontal surface of the non-woven drainage fabric.
- b. Where flashing is extended 1.5 inches beyond the face of the wall or lintel angle trim the flashing flush with the wall or lintel angle after inspection by agreed upon parties.

F. Horizontal Masonry, Concrete and Steel Surfaces:

1. Flashing shall be laid with the non-woven wicking fabric facing up in three continuous beads of polyether sealant and topped with a full bed of mortar at masonry lugs and at masonry/grout lugs. At loose lintels, and masonry/stone sills lay the non-woven fabric facing up in two continuous beads of polyether sealant and topped with a full bed of mortar. Flashing shall be carried through the wall. Install the factory cut edge flush with exterior masonry or extend flashing 1.5 inches beyond edge of masonry, concrete or steel edge. The first sealant bead shall be installed near the leading edge of the concrete, masonry or steel surface with two additional beads of sealant spaced at 3 inches on center at masonry lugs and masonry/grout lugs and one additional bead spaced two inches on center at loose lintels, and masonry /stone sills. Do not allow sealant to run beyond the concrete/masonry/steel edge when the flashing is pushed into the sealant. At all terminations, turn ends of flashings up at sides a minimum of 2 inches forming a pan. All corners shall be folded or use preformed end dams, do not cut. Seal with polyether sealant.
 - a. Where flashing is extended 1.5 inches beyond the face of the wall or lintel angle trim the flashing flush with the wall or lintel angle after inspection by agreed upon parties.
 - b. Where self-adhered flashing is used the horizontal leg of the flashing is not required to be set in a continuous bead of polyether sealant.

- c. At all steel lintels over openings, prior to installing flashing install a continuous stainless steel drip edge. Set drip plate over horizontal leg of steel lintel in two continuous beads of polyether sealant. Install drip edge so the face of the 30- degree edge is 1 inch from the face of the masonry above the lintel. Cut the drip edge at each jamb. Continue the flat plate the length of the angle that bears on the masonry. The first sealant bead shall be installed near the leading edge of the steel lintel surface with one additional bead spaced two inches on center. Do not allow sealant to run beyond the steel edge when the drip edge is pushed into the sealant. All laps shall be 3 inches with a bead of polyether sealant between laps and with a bead of sealant on the top edges of the overlap. Install flashing membrane on top of drip edge in accordance with the Horizontal Masonry, Concrete and Steel Surface paragraph.

G. Joining Materials:

1. Joints shall be a minimum of 6 inches wide on either side of the joint and made by butting the ends of the through wall flashing together using one of the following methods:
 - a. Splice end joints over 12-inch-wide piece of self-adhering stainless-steel flashing. Install the self-adhering stainless-steel flashing with metal face down, set in multiple beads of polyether sealant per Horizontal, Concrete and Steel Surfaces paragraph. Remove the release liner and imbed the through wall flashing with the non-woven wicking fabric side up in the butyl adhesive. Seal butt seam with polyether sealant.
 - b. Splice end joints over 12-inch-wide piece of Multi-Flash SS stainless-steel fabric flashing. Bond the Multi-Flash to the surface using multiple beads of polyether sealant and bond through wall flashing to the Multi-Flash using multiple beads of polyether sealant per Horizontal, Masonry Concrete Steel Surfaces paragraph. Seal butt seam with polyether sealant.
 - c. Where self-adhered flashing is used splice end joints by butting ends together over 4-inch-wide piece of York 304 self-adhering stainless-steel flashing. The York 304 self-adhered stainless-steel flashing shall be installed metal face up on to the substrate. Seal the butt seams of self-adhered flashing with polyether sealant.

H. End Dams:

1. Openings in the Wall: Where flashing is not continuous, the ends of the flashing shall be extended beyond the jamb lines on both sides and turned up a minimum of 2 inches into the head joint to form an end dam. Seal with polyether sealant. Refer to Head and Sill Flashing paragraph above for flashing that terminate at ends of openings.
2. Bottoms of Door Frames and/or Window Frames: The ends of the flashing on each side of the door and/or window frames shall be turned up a minimum of 4 inches into the head joint to form an end dam. Seal with polyether sealant.

I. Inside and Outside Corners:

1. Make in industry-accepted manner using corner and splice material or utilize preformed corners from manufacturer.
- J. All penetrations in the through wall flashing shall be sealed with a sealant approved by the flashing manufacturer.

END OF SECTION

SECTION 07 72 10 – ROOF CURBS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes:
 - 1. Manufactured Equipment Curbs.

1.02 RELATED SECTIONS

- A. Section 05 31 23 – Steel Roof Decking.
- B. Section 06 10 53 – Miscellaneous Carpentry: Securing curb to pressure-treated wood.
- C. Section 07 21 16 – Blanket Insulation: Installing stone wool batt insulation inside the equipment curb.
- D. Section 07 54 23 – Thermoplastic Polyolefin Roofing.
- E. Section 07 62 00 – Sheet Metal Flashings and Trim.
- F. Division 23 for roof-mounted equipment and pipe chase housings.

1.03 REFERENCES

- A. National Roofing Contractors Association:
 - 1. NRCA – The NRCA Roofing and Waterproofing Manual.
- B. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA – Architectural Sheet Metal Manual.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
- C. Product Data: Submit data on shape of components, materials and finishes, anchor types and locations.
- D. Manufacturer's Installation Instructions: Submit instructions for special procedures and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with NRCA details.

PART 2 PRODUCTS

2.01 MANUFACTURED EQUIPMENT CURBS

- A. Manufacturers/Products:
 - 1. The Pate Co., es-2.
 - 2. Roof Products, Inc., Model RPES-3.
 - 3. ThyBar, Model TEMS-3.
 - 4. Substitutions: Section 01 60 00 – Product Requirements.
- B. Materials:
 - 1. ASTM A653 G90 – hot-dipped galvanized steel. Minimum 18-gauge or heavier as engineered by manufacturer.
 - 2. Internal bulkhead reinforcement.
 - 3. 18-gauge counterflashing.
 - 4. Wood nailers: Factory installed, pressure treated.
- C. Construct equipment supports to match roof slope with plumb and level top surface for mounting equipment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify deck, wood nailers and other items affecting Work of this section are in place and positioned correctly.

3.02 INSTALLATION

- A. Install curbs in accordance with manufacturer's instructions and as indicated on Drawings.
- B. Isolate flange from pressure-treated wood with a layer of:
 - 1. Where TPO roof membrane is installed use a piece of TPO membrane.
- C. Coordinate installation of components of this section with installation of roofing membrane and base flashings.
- D. Coordinate installation of sealants and roofing cement with Work of this section to ensure water tightness.

- F. At equipment curbs install 3 ½- inch stone wool batt insulation in accordance with Section 07 21 16.

END OF SECTION

SECTION 07 72 33 – ROOF HATCHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prefabricated roof hatch with integral support curbs, operable hardware, counterflashings, and safety railing.

1.02 RELATED SECTIONS

- A. Section 05 50 00 – Metal Fabrications: Ladder for access to roof.
- B. Section 06 10 53 – Miscellaneous Carpentry: Wood nailers.
- C. Section 07 54 23 – Thermoplastic Polyolefin Roofing.
- D. Section 07 62 00 – Sheet Metal Flashings and Trim: Flashing to roof system.

1.03 REFERENCE STANDARDS

- A. ASTM A500/A500M – Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2007.
- B. Occupational Safety & Health Administration (OSHA): 29 CFR 1910.23 – Fixed Ladders.
- C. Occupational Safety & Health Administration (OSHA): 29 CFR 1910.29 – Guarding Floor and Wall Openings and Holes.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide data on unit construction, sizes, configuration, jointing methods and locations when applicable, and attachment method.
- C. Manufacturer's Installation Instructions: Indicate special installation criteria, interface with adjacent components.
- D. Certificate: Certify that products of this section meet or exceed specified requirements.

PART 2 PRODUCTS

2.01 36-INCH BY 30-INCH ROOF HATCH

- A. Manufacturers/Products
 - 1. Babcock-Davis: Product BRHUG- BG3630
 - 2. Bilco Co.: Product Type S-20
 - 3. DUR-RED: Product LH

4. Substitutions: Section 01 60 00 – Product Requirements.

B. Construction

1. Unit: 36 inches by 30 inches size, single leaf type.
2. Integral Steel Curb: Minimum 14- gauge galvanized steel with a minimum 1 inch rigid glass fiber insulation; integral cap flashing to receive roof flashing; extended flange for mounting; minimum height from top of curb to top of roof membrane surface of 12 inches.
3. Flush Steel Cover: Minimum 14- gauge galvanized steel; minimum 1- inch glass fiber insulation; sandwiched by 22 -gauge steel interior liner; continuous neoprene gasket to provide weatherproof seal.

C. Hardware:

1. Compression spring operator and shock absorbers.
2. Steel manual pull handle for interior and exterior operation.
3. Steel hold open arm with vinyl covered grip handle for easy release.
4. Components, zinc-plated finish.
5. Interior padlock provision.

D. Hinges: Manufacturer's recommended type for specific type of roof hatch.

E. Fabrication

1. Fabricate components free of visual distortion or defects. Weld corners and joints.
2. Provide for removal of condensation occurring within components or assembly.
3. Fit components for weathertight assembly.
4. Sloped Roofs: Fabricate roof hatch curbs tapered to maintain hatch top level.

G. Accessories:

1. Anchorage Devices: Type recommended by manufacturer.
2. Counterflashing: Same metal type and finish as roof hatch frame.
3. Underlayment at Thermoplastic Polyolefin Roofing: Same sheet material specified in Section 07 54 23.

2.02 ROOF HATCH FALL PROTECTION SAFETY RAIL SYSTEM

A. Basis of Design: SafePro L.P., Roof Hatch Fall Protection Safety Rail:

1. Model No. SP-3036L for 30 inches by 36 inches roof hatch.
 2. Substitutions permitted in accordance with this specification and Section 01 60 00.
- B. Description: Steel tube railing system mounted on roof hatch providing an ergonomically correct power grip in a safe upright egress and ingress through roof hatches in addition to protection from accidental falls through roof opening while roof hatch is open. Includes top and mid-rail and wrap-around self-closing gravity gate mounted with heavy-duty hinges acting as a ladder extension.
1. Steel Tubing: 1-1/2 inch cold-rolled electric welded steel tubing, ASTM A500, Grade B, cold formed.
 2. Size: Formed to fit roof hatch size of 36 inches by 30 inches, 30 inches by 54 inches or 30 inches by 96 inches.
 3. Height: 42 inches above roof surface when mounted on standard roof hatch cap flashing.
 4. Mounting System: Integrated stanchions of rail system through bolted to extended cap flashing of roof hatch using 3/8 inch bolts.
 5. Gate System: Gravity self-closing, non-collapsible full wrap-around steel tubing grab hold, welded construction. Heavy-duty hinges with 5/8 inch hinge pin with built-in pinchless gate stop and pull-up full open positioning.
 6. Fasteners: Stainless steel 316 Grade Hex head bolts, 3/8 inch by 2 inch, nylon locking hex nut and flat washers.
 7. Labels: Furnish with manufacturer's standard labels containing safety warning, fall dangers, "No Hoisting" warning and manufacturer identification.
- C. Performance:
1. Safety rails shall meet and exceed OSHA Standard CFR 29 1910.29. No exceptions allowed.
- D. Fabrication: Factory formed and fully welded construction, free of sharp edges and snag points.
- E. Finish: Factory finished with powder coating.
1. Powder Coat Finish: Manufacturer's standard powder coating. Color: Safety Yellow.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate with installation of roofing system and related flashings for weathertight

installation.

- C. Isolate nailing flange in contact with preservative-treated wood with:
 - 1. At Thermoplastic Polyolefin Roofing, Section 07 54 23, isolate nailing flange in contact with preservative-treated wood with a layer of TPO roofing.
- D. Install safety railing in accordance with manufacturer's instructions at each new roof hatch.
- E. Final installation to be watertight assembly.
- F. Adjust hinge for smooth operation.
- G. If roof curb height is not in itself sufficient to produce the minimum height of 12 inches from the top of curb to surface of roof membrane, add treated wood nailers to achieve the minimum clearance

END OF SECTION

SECTION 07 84 00 – FIRESTOPPING

PART 1 GENERAL

1.01 RELATED SECTIONS

- A. Division 21 – Fire Suppression: Fire protection work requiring firestopping.
- B. Division 23 – Heating, Ventilating and Air Conditioning (HVAC): HVAC work requiring firestopping.
- C. Division 26 – Electrical: Electrical work requiring firestopping.

1.02 GENERAL DESCRIPTION OF THE WORK OF THIS SECTION

- A. Only tested firestop systems shall be used in specific locations as follows:
 - 1. Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire barriers.
 - 2. Openings around structural members which penetrate walls.
- B. Special Inspections and Tests:
 - 1. A qualified independent testing laboratory and inspection agency, selected and paid by Owner and approved by Architect, will perform special inspection, professional testing and laboratory services specified herein. The Inspector shall meet the requirements of ASTM E2174.
 - 2. Penetration firestops: Field inspection of penetration firestop systems shall be in accordance with ASTM E2174.
 - a. General: The inspector shall verify compliance of the fire penetration firestop system by observing the installation process then taking and recording measurements of the substrates and materials being installed or by destructive examination of completed installations.
 - b. Method of inspection shall be one of the following methods as approved by the authorizing authority (AA) which shall be the designated person, or organization, or their duly authorized representative, charged with the administration and enforcement of the provisions of ASTM E2174 and the authority having jurisdiction (AHJ).
 - 1) Method 1: The inspector shall be on site during during the installation of the penetration firestop system and shall randomly witness a minimum of 10 percent of each type of penetration firestop system, or
 - 2) Method 2: The inspector shall conduct a post installation inspection, which shall require the destructive type verification of the penetration firestop system and the repair of the firestop system. A minimum of 2 percent, but not less than one, of each type of firestop system shall be inspected per floor or for each area of a floor when the floor is larger than 10,000 square feet.

- c. Repair, replacement and re-inspection:
 - 1) Method 1: Any type of firestop system observed during the installation of the penetration firestop system in Method 1 that does not comply with the inspection shall be repaired or replaced plus one full additional inspection of the percentage specified in Method 1 of that type of firestop system that failed inspection shall be performed by the contractor. The cost to repair, replace and re-inspect the non-compliant fire stop system shall be paid for by the contractor, with no additional cost to the Owner. In addition, the cost to provide one full additional inspection as noted shall be paid for by the contractor with no additional cost to the Owner.
 - 2) Method 2: If the post installation method is selected, any type of firestop system that does not comply with the inspection shall be repaired or replaced and re-inspected plus one full additional inspection of the percentage specified in Method 2 of that type of firestop system that failed inspection shall be performed by the contractor. The cost to repair, replace and re-inspect the non-compliant fire stop system shall be paid for by the contractor, with no additional cost to the Owner. In addition, the cost to provide one full additional inspection as noted shall be paid for by the contractor with no additional cost to the Owner.
 - 3) All repairs/replacement of firestop systems shall be conducted according to the manufacturers recommended procedures and methods.
- 3. Fire-resistant joint systems: Field inspection of fire-resistant joint systems shall be in accordance with ASTM E2393.
 - a. General: The inspector shall verify compliance of the fire resistive joint system by observing the installation process then taking and recording measurements of the substrates and materials being installed or by destructive examination or disassembly of completed installations.
 - b. Method of inspection shall be one of the following methods as approved by the authorizing authority (AA) which shall be the designated person, or organization, or their duly authorized representative, charged with the administration and enforcement of the provisions of ASTM E2393 and the authority having jurisdiction (AHJ).
 - 1) Method 1: The inspector shall be on site during installation and randomly witness a minimum of 5 percent of the total linear feet of each type of fire resistive joint system being installed, or
 - 2) Method 2: The inspector shall conduct a post-installation inspection using one of the two options below, in accordance with ASTM E2393, except for mechanical systems, which shall be inspected per Method 1 above.
 - i. Option 1: Destructive type verification of the fire resistive joint system and the repair of the joint system. The destructive inspection shall consist of a minimum of one sampling per type of joint system per 500 linear feet.
 - ii. Option 2: Disassembly and verification of the components and reinstallation of the joint system.

The disassembly inspection shall consist of a minimum of one sampling per type of joint system per 500 linear feet.

- c. Repair, replacement and re-inspection:
- 1) Method 1: Any type of fire resistive joint system observed during the installation of the fire resistive joint system in Method 1 that does not comply with the inspection shall be repaired or replaced plus one full additional inspection of the percentage specified in Method 1 of that type of fire resistive joint system that failed inspection shall be performed by the contractor. The cost to repair, replace and re-inspect the non-compliant fire resistive joint system shall be paid for by the contractor, with no additional cost to the Owner. In addition, the cost to provide one full additional inspection as noted shall be paid for by the contractor with no additional cost to the Owner.
 - 2) Method 2: If the post installation method is selected, Option 1 or 2, any type of fire-resistant joint system that does not comply with the inspection shall be repaired or replaced and re-inspected plus one full additional inspection of the number specified in Method 2, Option 1 or 2, of that type of fire-resistant joint system that failed inspection shall be performed by the contractor. The cost to repair, replace and re-inspect the non-compliant fire resistive joint system shall be paid for by the contractor, with no additional cost to the Owner. In addition, the cost to provide one full additional inspection as noted shall be paid for by the contractor with no additional cost to the Owner.
 - 3) All repairs/replacement of fire resistive joint systems shall be conducted according to the manufacturers recommended procedures and methods.

1.03 REFERENCES

A. ASTM International:

1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 – Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 – Standard Test Method for Fire-Resistive Joint Systems.
5. ASTM E2174 – Standard Practice for On-Site Inspection of Installed Firestops.
6. ASTM E2307 – Standard Test Method for Determining Fire Resistance of a Perimeter Joint System Between an Exterior Wall Assembly and Floor Assembly Using the Intermediate-scale, Multistory Test Apparatus.
7. ASTM E2393 – Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.

- B. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH – Certification Listings.
- C. National Fire Protection Association:
 - 1. NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 – Fire Tests of Building Construction and Materials.
 - 2. UL 723 – Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 – Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 – Tests for Fire Resistance of Building Joint Systems.
 - 5. UL – Fire Resistance Directory.

1.04 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide firestopping systems that are produced and installed to resist the spread of fire, according to requirements indicated and the passage of smoke and other gases.
- B. Through-Penetration Firestop Systems for Fire-Resistance-Rated Walls: Through penetrations shall be protected by an approved penetration firestop system installed as tested in accordance with ASTM E814 or UL 1479, with a minimum positive pressure differential of 0.01 inch of water and shall have an F rating of not less than the required fire-resistance rating of the wall penetrated.
- C. Fire-Resistive Joint Sealants: Provide joint sealants with fire-resistance ratings indicated, as determined per ASTM E119, but not less than that equaling or exceeding the fire resistance rating of the construction in which the joint occurs.
- D. Fire-Resistive Joint Systems: Fire-resistive joint systems shall be tested in accordance with the requirements of either ASTM E1966 or UL 2079.
- E. For firestopping exposed to view, traffic, moisture and physical damage, provide products that do not deteriorate when exposed to these conditions.
 - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
 - 2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- F. For firestopping exposed to view, provide products with flame-spread values of less than 25 and smoke-developed values of less than 450, as determined per ASTM E84.

1.05 SUBMITTALS

- A. Product data for each type of product specified.
 - 1. Certification by firestopping manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs) and are nontoxic to building occupants.
- B. Shop Drawings detailing materials, installation methods and relationships to adjoining construction for each through-penetration firestop system and each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of qualified testing and inspecting agency evidencing compliance with requirements for each condition indicated.
 - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop configuration for construction and penetrating items.
 - 2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration approved by firestopping manufacturer's fire protection engineer with modifications marked.
- C. Product certificates signed by manufacturers of firestopping products certifying that their products comply with specified requirements.
- D. Product test reports from, and based on tests performed by, a qualified testing and inspecting agency evidencing compliance of firestopping with requirements based on comprehensive testing of current products.
- E. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners and other information specified.

1.06 QUALITY ASSURANCE

- A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- B. Fire-Test-Response Characteristics: Provide firestopping that complies with the following requirements and those specified under the "System Performance Requirements" article:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, Warnock Hersey or another agency, performing testing and follow-up inspection services for firestop systems, that is acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per ASTM E814 under conditions where positive furnace pressure differential of at least 0.01-inch of water (2.5 Pa) is maintained at a distance of 0.78-inch (20 mm) below the fill materials surrounding the penetrating items in the test assembly.

Provide rated systems complying with the following requirements:

- a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by UL in their "Fire Resistance Directory," by Warnock Hersey or by another qualified testing and inspecting agency.
3. Fire-resistive joint sealant systems are identical to those tested for fire-response characteristics per ASTM E119 under conditions where the positive furnace pressure differential is at least 0.01-inch of water (2.5 Pa), as measured 0.78-inch (20 mm) from the face exposed to furnace fire. Provide systems complying with the following requirements:
- a. Fire-Resistance Ratings of Joint Sealants: As indicated by reference to design designations listed by UL in their "Fire Resistance Directory" or by another qualified testing and inspecting agency.
 - b. Joint sealants, including backing materials, bear classification marking of qualified testing and inspection agency.
- C. Information on Drawings referring to specific design designations of through-penetration firestop systems is intended to establish requirements for performance based on conditions that are expected to exist during installation. Any changes in conditions and designated systems require the Architect's prior approval. Submit documentation showing that the performance of proposed substitutions equals or exceeds that of the systems they would replace and are acceptable to authorities having jurisdiction.
- D. Installer Qualifications: Engage an experienced installer who is certified, licensed or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff and training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.
- E. Single-Source Responsibility: Obtain through-penetration firestop and fire-resistant joint systems for each kind of penetration and construction condition indicated from a single manufacturer.
- F. Provide firestopping products containing no detectable asbestos as determined by the method specified in 40 CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Masonry."
- G. Coordinating Work: Coordinate construction of openings and penetrating items to ensure that designated through-penetration firestop systems are installed per specified requirements.
- H. For those firestop applications that exist for which no UL tested system is available through a manufacturer, an engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment Drawings must follow requirements set forth by the International Firestop Council.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver firestopping products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacturer; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time and mixing instructions for multicomponent materials.
- B. Store and handle firestopping materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants or other causes.

1.08 PROJECT CONDITIONS

- A. Environmental Conditions: Do not install firestopping when ambient or substrate temperatures are outside limits permitted by firestopping manufacturers or when substrates are wet due to rain, frost, condensation or other causes.
- B. Ventilation: Ventilate firestopping per firestopping manufacturers' instructions by natural means or, where this is inadequate, forced air circulation.

1.09 SEQUENCING AND SCHEDULING

- A. Do not cover up those firestopping installations that will become concealed behind other construction until the owner's representative and authorities have jurisdiction, if required, have examined each installation.

PART 2 PRODUCTS

2.01 FIRESTOPPING – GENERAL

- A. Basis of Design: Contract Documents are based on manufacturer and product names listed in the firestop schedule below to establish a Standard of Quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and does not change concept as expressed in Contract Documents as judged by Architect.
 - 1. Hilti
 - a. Firestop material used at head wall conditions shall be tested with specified fireproofing.
 - 2. Refer to each test number for:
 - a. Safing insulation.
 - b. Board insulation.
 - c. Pipe insulation.
- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit as substitution according to Conditions of the Contract and appropriate Division 1 sections.
 - 1. Specified Technologies Inc.

2. Tremco.
 3. USG.
- C. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- D. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include, but are not limited to, the following items:
1. Permanent forming/damming/backing materials including the following:
 - a. Semi-refractory fiber (mineral wool) insulation, 4 pcf, and 8 pcf density as required, formaldehyde free.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated formboard.
 - e. Joint fillers for joint sealants.
 2. Temporary forming materials.
 3. Substrate primers.
 4. Collars.
 5. Steel sleeves.
- E. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

2.02 MIXING

- A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:
 - 1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.
 - 2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of development optimum bond with firestopping. Remove loose particles remaining from cleaning operation.
 - 3. Remove laitance and form release agents from concrete.
- B. Priming: Prime substrates where recommended by firestopping manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent firestopping from contacting adjoining surfaces that will remain exposed upon completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestopping materials. Remove tape as soon as it is possible to do so without disturbing firestopping's seal with substrates.
- D. Verify sleeves in openings are steel. Remove any plastic sleeves and replace with steel sleeves. Sleeves shall be secured to the masonry walls.

3.03 INSTALLING THROUGH-PENETRATION FIRESTOPS

- A. General: Comply with the "System Performance Requirements" article in Part 1 and the through-penetration firestop manufacturer's installation instructions and Drawings pertaining to products and applications indicated.
- B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross-sectional shapes and depths required to achieve fire ratings of designated through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:
 - 1. Completely fill voids and cavities formed by openings, forming materials, accessories and penetrating items.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 INSTALLING FIRE-RESISTIVE JOINT SEALANTS

- A. General: Comply with the "System Performance Requirements" article in Part 1, with ASTM C1193 and with the sealant manufacturer's installation instruction and Drawings pertaining to products and applications indicated.
- B. Install joint fillers to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability and develop fire-resistance rating required.
- C. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint width that optimum sealant movement capability. Install sealants at the same time joint fillers are installed.
- D. Tool non-sag sealants immediately after sealant application and prior to the time skinning or curing begins. Form smooth, uniform beds of configuration indicated or required to produce fire-resistance rating, as well as to eliminate air pockets and to ensure contact and adhesion of sealants with sides of joint. Remove excess sealant from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.05 FIELD QUALITY CONTROL

- A. All penetration firestop systems shall be examined by an appointed code official general contractor and/or inspecting agency employed and paid by Owner. All firestop penetrations shall be examined for complete firestopping to determine, in general, if it is being installed in compliance with requirements.
 - 1. Refer to Article 1.02, Paragraph B for special inspection and testing of firestopping and fire-resistant joint systems.
- B. Inspecting agency will report observations promptly and in writing to Contractor and Architect.
- C. Do not proceed to enclose firestopping with other construction until reports of examinations are issued.
- D. Where deficiencies are found, repair or replace firestopping so that it complies with requirements.

3.06 CLEANING

- A. Clean off excess fill materials and sealants adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.
- B. Protect firestopping during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated firestopping immediately and install new materials to produce firestopping

complying with specified requirements.

3.07 LOCATIONS

- A. Penetrations through all fire-resistance-rated walls including both empty openings and openings containing cables, pipes, ducts, conduits and other penetrating items.
- B. Sealant joints in fire-resistance-rated construction.

3.08 FIRESTOP SCHEDULE

I. WALLS – GYPSUM WALLBOARD AND METAL STUD CONSTRUCTION

A. Single Metal Pipe/Conduit or Tubing:

1. Pipe Sizes:

- a. Steel Pipe: Nom. 30 inches diameter (or smaller), schedule 10 (or heavier) steel pipe.
- b. Cast Iron Pipe: Nom. 30 inches diameter (or smaller) cast or ductile iron pipe.
- c. Steel Conduit: Nom. 6 inches diameter (or smaller) steel conduit.
- d. Electrical Metal Tubing: Nom. 4 inches diameter (or smaller) electrical metal tubing.
- e. Copper Pipe: Nom. 6 inches diameter (or smaller) regular (or heavier) copper pipe.
- f. Copper Tubing: Nom. 6 inches diameter (or smaller) Type L (or heavier) copper tubing.

2. Rating: F, 1 Hour or 2 Hour.

3. UL Number: WL 1054.

4. Manufacturer/Product: Hilti Construction Chemicals, Inc./FS-One MAX Intumescent Firestop Sealant.

- a. VOC content: 9 g/L.

5. Annular space around penetration: 0 inch minimum to 2-1/4 inches maximum.

6. Firestop System: Construct firestop in accordance with UL Design Number.

B. Multiple Penetrations:

1. Cables, through penetrations.

- a. Steel or aluminum cable tray (maximum 18 inches by 6 inches) bearing UL classification mark.
- b. Cables: Aggregate cross-sectional area of cables in cable tray to be maximum 30% of the cross-sectional area of the cable tray.
 - 1) 7/C No. 12 AWG with PVC insulation and PVC jacket.
 - 2) 100 pair No. 24 AWG cable with PVC insulation and jacket.
 - 3) 1/C, 750 kcmil (or smaller) with PVC insulation and jacket.

- c. Maximum 3 inches diameter PVC schedule 40 solid core PVC pipe (or smaller) for use in closed (process or supply) or vented (drain, waste or vent) piping system.
 - d. Steel pipe: Nominal 6 inches diameter (or smaller), schedule 40 (or heavier) steel pipe.
 - e. Conduit: Nominal 4 inches diameter (or smaller) EMT or 4 inches diameter steel conduit.
 - f. Copper pipe: Nominal 4 inches diameter (or smaller) regular (or heavier) copper pipe.
 - g. Copper tube: Nominal 4 inches diameter (or smaller) Type L (or heavier) copper tube.
 - h. Cable Bundles
 - 1) 7/C No. 12 AWG with PVC insulation and PVC jacket.
 - 2) 25 pair No. 24 AWG cable with PVC insulation and jacket.
 - 3) Type R GU/59 coaxial cable with PVC outer jacket.
 - 4) 24 fiber optic cable with PVC sub unit and outer jacket.
2. Rating: F, 1 Hour or 2 Hour.
 3. UL Number: WL 8013.
 4. Manufacturer/Product: Hilti CFS-BL Fire Block, FS-One MAX Intumescent Firestop sealant.
 - a. VOC content CFS-BL: 5.4 g/L.
 - b. VOC content sealant: 9 g/L.
 5. Firestop System: Construct firestop in accordance with UL Design Number.
- C. Cables (Single or Multiple)
1. Cable Sizes
 - a. Max. 7/C No. 12 AWG with PVC insulation and jacket.
 - b. Max. 25 pair No. 24 AWG phone cables with PVC insulation and jacket.
 - c. Type RG/U coaxial cable with PE insulation and PVC jacket having a max. outside dia. of 1/2 inch.
 - d. Multiple fiber optical communications cable jacketed with PVC and having a max. outside dia. of 5/8 inch.
 - e. Through Penetrating Products: Max. three copper conductor No. 8 AWG. Metal-clad cables.
 - f. Max. 3/C (with ground) (or smaller) No. 8 AWG copper conductor cable with PVC insulation and jacketing.
 - g. Max. 3/4 inch diam. copper ground cable with or without a PVC jacket.
 - h. Fires-resisting cables: Max. 1 1/4 inches dia. single conductor or multi-conductor Type MI cable. A min. 1/8 inch separation shall be maintained between MI cables and any other cable.
 2. Rating: F, 1 hour or 2 hour.
 3. UL Number: WL 3065.

4. Manufacturer/Product: Hilti Construction Chemicals, Inc./FS-One MAX Intumescent Firestop Sealant.
 - a. VOC content: 9 g/L.
 5. Pipe Sleeve: Optional nominal 4 inches diameter (or smaller) steel EMT or Schedule 5 (or heavier) steel pipe or min. 0.016 inch thick galv. steel sleeve. Set sleeve flush with wall.
 6. Annular Space: Minimum 0 inch to maximum 1 inch
 7. Aggregate cross-sectional area of cable in opening to be maximum 45% of the cross-sectional area of the opening. Fill annular space with a minimum 5/8 inch depth of FS-One firestop sealant on each side of opening for one and two hour rating. Construct firestop in accordance with UL Design Number.
- D. Plastic Pipe:
1. Pipe Sizes:
 - a. Polyvinyl Chloride (PVC) Pipe: Nom. 10 inches diam. (or smaller) Schedule 40 solid-core or cellular core PVC pipe for use in closed (process or supply) or vented (drain, waste or vent) piping system.
 - b. Chlorinated Polyvinyl Chloride (CPVC) Pipe: Nom. 10 inches diam. (or smaller) SDR 13.5 CPVC pipe for use in closed (process or supply) systems only.
 - c. Acrylonitrile Butadiene Styrene (ABS) Pipe: Nom. 6 inches diam. (or smaller) Schedule 40 solid-core or cellular core ABS pipe for use in closed (process or supply) or vented (drain, waste or vent) piping systems.
 - d. Flame Retardant Polypropylene (FRPP) Pipe: Nom. 6 inches diam. (or smaller) Schedule 40 FRPP pipe for use in closed (process or supply) or vented (drain, waste or vent) piping system.
 - e. Polyvinylidene Fluoride (PVDF) Pipe: Nom. 4 inches diam. (or smaller) PVDF pipe for use in closed (process or supply) or vented (drain, waste or vent) piping system.
 2. Rating: F, 1 hour or 2 hour.
 3. UL Number: WL2078.
 4. Manufacturer/Product: Hilti Construction Chemicals, Inc./Hilti CP643N firestop collar and FS-One MAX Intumescent Firestop Sealant.
 - a. CP643N VOC content: 7.6 g/L.
 - b. Sealant VOC Content 9 g/L.
 5. Install firestop collar to both sides of wall using anchor hooks.
 6. Annular Space: Minimum 0 inch to Maximum 1/2 inch
- E. Insulated Metal Pipes:
1. Pipe Sizes:

- a. Steel Pipe: Nom. 12 inch diameter (or smaller) schedule 10 (or heavier).
 - b. Iron Pipe: Nom. 12 inch diameter (or smaller) cast or ductile iron pipe.
 - c. Copper Tubing: Nom. 6 inches diameter (or smaller) Type L (or heavier) copper tubing.
 - d. Copper Pipe: Nom. 6 inches diameter (or smaller) regular (or heavier) copper pipe.
2. Rating: F, 1 hour or 2 hour.
 3. UL Number: WL5029
 4. Manufacturer/Product: HILTI Retaining collar with FS-One MAX Intumescent firestop sealant.
 - a. VOC content: 9 g/L.
 5. Annular space: Minimum 0 inch, Maximum 1-7/8 inches
 6. Insulation: Nominal 1 inch, 1-1/2 inches, or 2-inch thick glass-fiber pipe insulation or maximum 2-inch thick calcium silicate pipe insulation.
 7. Firestop System: Construct firestop in accordance with UL Design Number.
- II. HEAD OF WALL AT RATED METAL STUD AND GYPSUM BOARD WALLS, METAL ROOF DECK
- A. Rating: 1 Hour and 2 Hour.
 - B. UL Number: HW-D-0042 and HW-D-0049.
 1. Forming Material: Minimum, 4 pcf density mineral wool batt insulation firmly packed into flutes of steel deck for 1 hour and 2 hour rated walls respectively, flush with wall surface, as per UL design requirements.
 - a. Safing: Owens Corning Thermafiber Safing FF Formaldehyde-Free Mineral Wool Safing Insulation.
 - b. At HW-D-0042 assemblies where studs are 3 1/2 inch and wider provide as an alternate to 1a above Hilti preformed mineral wool plugs, CP777 Speed Plugs.
 2. Fill Material: Min 1/8 inch thick (wet) Hilti CFS-SP WB firestop joint spray.
 - a. VOC content: 34 g/L.
- III. CONTROL JOINTS IN RATED GYPSUM BOARD AND METAL STUD PARTITIONS
- A. Fill joint with Owens Corning Thermafiber Safing FF Formaldehyde-Free Mineral Wool Safing Insulation, 4.0 pcf.

IV. FLOOR TO WALL AT RATED METAL STUD AND GYPSUM BOARD WALLS

- A. Fill the joint between the floor and edge of gypsum wallboard at rated and non-rated partitions with Hilti CP606.
1. VOC content: 71 g/L.

V. CABLE TRAY THROUGH 1- OR 2-HOUR GYPSUM BOARD WALLS

- A. Cables: Any combination of the following:
1. Maximum 1/C 750 kcmil (or smaller) single conductor power cable with EPR insulation and PVC jacket.
 2. Maximum 300 pair-No. 24 AWG cable with PVC insulation and jacket.
 3. Maximum 24 1/2 inch diameter fiber-optic cable.
 4. Maximum 3/C, No. 12 AWG metal-clad cable.
- B. Rating: 1 or 2 Hour.
- C. UL Number: W-L-4011.
- D. Manufacturer/Product: Hilti Construction Chemicals, Inc. FS 657 fire blocks, FS-One MAX Intumescent Firestop Sealant.
1. VOC content: 9 g/L.
- E. Annular Space: Minimum 0 inch to Maximum 4 inches.
- F. Open Ladder UL Classified Cable Tray: Maximum 24 inches by 6 inches steel or aluminum.
- G. Apply FS-One MAX into interstices of cables, between cables and cable tray and any voids.

VI. PROTECTION OF ELECTRICAL BOXES IN 1- AND 2-HOUR RATED METAL STUD AND GYPSUM WALLBOARD PARTITIONS

- A. Hilti CLIV CP617 Firestop Putty Pad.
1. VOC content: 4.35 g/L.
- B. Install around each outlet box located within a fire-rated partition or fire barrier.

END OF SECTION

SECTION 07 90 00 – JOINT PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparing substrate surfaces.
- B. Sealant and joint backing.
- C. Summary.
 - 1. Exterior joints in vertical surfaces, indicated below:
 - a. Control and expansion joints in veneer masonry, brick.
 - b. Control and expansion joints in stone and cast stone.
 - c. Perimeter joints between materials listed above and frames of doors and windows.
 - 1) Perimeter joint sealants specified in this section shall not come in direct contact with fluid applied membrane air barrier, tapes and sealants specified in Section 07 27 26.
 - d. Joints between different materials listed above.
 - e. Other joints indicated.
 - 2. Exterior joints in horizontal traffic surfaces as indicated below:
 - a. Control, expansion and isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.
 - 3. Interior joints in vertical surfaces and horizontal non-traffic surfaces as indicated below:
 - a. Perimeter joints of exterior openings where indicated.
 - 1) Coordinate type of joint sealant installed around the inside perimeter of exterior openings with Section 07 27 26 – Fluid-Applied Membrane Air Barrier. Sealants that come in direct contact with air barrier membrane and /or tapes shall be compatible with air barrier membrane and/or tapes. Where this condition occurs provide sealants specified in Section 07 27 26.
 - b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
 - c. Perimeter joints of toilet fixtures.
 - d. Other joints as indicated.

1.02 RELATED SECTIONS

- A. Section 04 20 00 – Unit Masonry: Sealants required in conjunction with concrete masonry units.

- B. Section 04 20 19 – Veneer Unity Masonry: Sealants required in conjunction with brick, and concrete masonry units.
- C. Section 04 43 13 – Mortar-Placed Stone Veneer: Sealants required in conjunction with stone units.
- D. Section 04 72 00 – Cast Stone Masonry: Sealants required in conjunction with stone units.
- E. Section 07 27 26 – Fluid-Applied Membrane Air Barrier: Sealants that are compatible with air barrier membrane and tapes.
- F. Section 07 62 00 – Sheet Metal Flashing and Trim.
- G. Section 07 65 10 – Flexible Flashing: Sealants required in conjunction with flexible flashings.
- H. Section 07 84 00 – Firestopping.
- I. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts: Sealants required in conjunction with glazing method.
- J. Section 08 42 29 – Sliding Automatic Entrances: Sealants required in conjunction with glazing method.
- K. Section 08 80 00 – Glazing: Sealants required in conjunction with glazing methods.
- L. Section 09 21 16 – Gypsum Board Assemblies: Sealants required in conjunction with acoustic treatment.

1.03 REFERENCES

- A. American Society for Testing and Materials:
 - 1. ASTM C661 – Standard Test Method for Indentation Hardness of Elastomeric Sealants by Means of a Durometer.
 - 2. ASTM C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement. (Hockman Cycle)
 - 3. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants.
 - 4. ASTM C834 – Standard Specification for Latex Sealants.
 - 5. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
 - 6. ASTM C1193 – Standard Guide for Use of Joint Sealants.
 - 7. ASTM C1248 – Standard Test Method for Staining of Porous Substrate by Joint Sealants.
 - 8. ASTM C1311 – Standard Specification for Solvent Release Sealants.

9. ASTM C1521 – Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
 10. ASTM E329 – Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- B. SWRI (Sealant, Waterproofing and Restoration Institute) – Sealant and Caulking Guide Specification.

1.04 ADHESION, COMPATIBILITY AND STAIN TESTS

- A. The General Contractor shall provide to sealant manufacturers, samples of all substrates which are in contact with sealant, regardless of whether adhesion must be achieved.
- B. For substrates which must support adhesion, submit to the Architect, for record only, sealant manufacturers' reports of adhesion tests conducted in accordance with ASTM C794.
- C. For stone (limestone, cast stone), submit to the Architect, for record only, sealant manufacturers' reports of stain tests for sealants and primers conducted in accordance with ASTM C1248.
- D. For all test results, submit manufacturers' recommendations for application and quality control procedures.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, color availability.
- C. Samples: Submit samples illustrating standard as well as expanded sealant colors.
 1. Provide custom colors where standard and expanded colors do not match Architect's color selections.
- D. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.
- E. Adhesion, compatibility and stain test reports per Article 1.04.
- F. Warranty: Include coverage for installed sealants and accessories failing to achieve airtight, watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.
 1. Silicone Warranty: 20 years.
 2. Urethane Warranty: 5 years.
 3. Warranty against staining stone: 20 years.
 4. Provide 2-year workmanship warranty for all sealants.

- G. Provide SWRI (Sealant and Waterproofing and Restoration Institute) Certification.

1.06 QUALITY ASSURANCE

- A. **Installer Qualifications:** Engage an experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with a record of successful in-service performance.
- B. **Testing Laboratory Qualifications:** To qualify for acceptance, an independent testing laboratory must demonstrate to Architect's satisfaction, based on evaluation of laboratory-submitted criteria conforming to ASTM E329, that it has the experience and capability to conduct satisfactorily the testing indicated without delaying progress of the Work.
- C. **Pre-Construction Compatibility, Adhesion Testing and Stain:** Submit to joint sealant manufacturer's samples of materials that will contact or affect joint sealants for compatibility and adhesion testing as indicated below:
 - 1. Use test methods standard with manufacturer to determine which specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - a. Perform tests under normal environmental conditions that will exist during actual installation.
 - 2. Submit not less than 9 pieces of each type of material, including joint substrates, shims, joint sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analysis of results to prevent delay in the progress of the Work.
 - 4. Investigate materials failing compatibility or adhesion tests and obtain joint sealant manufacturer's written recommendations for corrective measures, including use of specially formulated primers.
 - 5. Testing will not be required when joint sealant manufacturer is able to submit joint preparation data required above that are acceptable to Architect and are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.
- D. **Product Testing:** Provide comprehensive test data for each type of joint sealant based on tests conducted by a qualified independent testing laboratory on current product formulations within a 24-month period preceding date of Contractor's submittal of test results to Architect.
 - 1. Test elastomeric sealants for compliance with requirements specified by reference to ASTM C920. Include test results for hardness, stain resistance, adhesion and cohesion under cyclic movement (per ASTM C719), low-temperature flexibility, modulus of elasticity at 100 percent strain, effects of heat aging, and effects of accelerated weathering.
 - 2. Include test results performed on joint sealants after they have cured for 1 year.
- E. **Pre-Construction Field Testing:** Prior to installation of joint sealants, field-test their

adhesion to joint substrates as follows:

1. Locate test joints where indicated or, if not indicated, as directed by Architect.
 2. Conduct field tests for each application indicated below:
 - a. Each type of elastomeric sealant and joint substrate indicated.
 - b. Each type of non-elastomeric sealant and joint substrate indicated.
 3. Notify Architect one week in advance of the dates and times when mock-ups will be erected.
 4. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
 5. Test method to determine sealant adhesion characteristic in situ, per ASTM C1521, Method A.
 - a. Purpose: To detect field application problems, such as improper substrate cleaning, use of an improper primer, poor primer application, improper joint configuration.
 - b. Apply sealant to each sample substrate specified. Install joint sealants in 60-inch joint lengths, using same materials and methods for joint preparation and joint sealant installation required for completed work. Allow sealants to cure fully before testing.
 - c. The "Tail" Procedure consists of cutting through the sealant, 6 inches along the bond line at both substrates. Cut across the sealant bead to release one end of the "tail" that is formed per Figure 2 of ASTM C1521. Ensure that the sealant is cut at the substrate and that the sealant bead is free of nicks or jagged edges.
 - d. Grasp the 6-inch sealant tab firmly 1 inch from its bonded edge and pull at a 90-degree angle to effectively extend the 1-inch mark to two times the stated movement capability of the sealant.
 - e. Record the type of failure that occurred and the distance of the mark from the adhesive bond when failure occurred, or the distance recommended by manufacturer without causing failure.
 6. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.
- F. Field-Constructed Mock-Ups: Prior to installation of joint sealants, apply elastomeric sealants as follows to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution:
1. Joints in field-constructed mock-ups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants specified in this Section.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum ten years of documented experience.

- B. Applicator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in original, unopened containers or bundles with labels indicating manufacturer, product name and designations, color, expiration period for use, pot life curing time and mixing instructions for multicomponent requirements.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants or other causes.

1.10 PROJECT CONDITIONS

- A. Joint width: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- B. Joint substrate conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from the joint substrates.
- C. Temperature: Do not proceed with installation of joint sealants when ambient and substrate temperature conditions are outside the limits by joint sealant manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS – GENERAL

- A. Compatibility: Provide joint sealants, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and applications, as demonstrated by sealant manufacturer based on testing and field experience.
- B. Colors: Provide color of exposed to view joint sealants to comply with the following:
 - 1. At masonry, provide colors to match masonry and mortar colors.
 - a. At vertical expansion contraction joints, sealant color shall match masonry and/or stone.
 - b. At horizontal joints, sealant color shall match mortar color.
 - 2. Provide selections made by architect from manufacturer's full range of standard colors for products of type indicated. Provide custom colors where the manufacturer's standard colors do not match masonry.

2.02 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing Elastomeric sealant that complies with ASTM C920 and other requirements indicated on each Elastomeric joint sealant data sheet at the end of this section, including those requirements referencing ASTM C920 classifications for type, grade, class and uses.
 - 1. Additional Movement Capability: Where additional movement capability is specified in Elastomeric joint sealant data sheet, provide products with the capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C719, to withstand the specified percentage change in the joint width existing at time of installation and remain in compliance with other requirements of ASTM C920 for uses indicated.
- B. Products: Subject to compliance with requirements, provide one of the products specified in each Elastomeric joint sealant data sheet.

2.03 LATEX JOINT SEALANTS

- A. General: Provide manufacturer's standard one-part, non-sag, non-staining, mildew-resistant, paintable latex sealant of formulation indicated that is recommended for exposed applications on interior and protected exterior locations and that accommodates indicated percentage change in joint width existing at time of installation without failing either adhesively or cohesively.
- B. Acrylic Latex Sealant: Provide product complying with ASTM C834.
- C. Products: Subject to compliance with requirements provide one of the following:
 - 1. Acrylic-Latex Sealant
 - a. "AC-20," Pecora Corp.
 - 1) VOC content: 31 g/L.
 - b. "Tremflex 834," Tremco
 - 1) VOC content: 11 g/L.

2.04 SOLVENT – RELEASES – CURING JOINT SEALANTS

- A. Butyl Sealant: Manufacturer's standard one-part, non-sag, solvent-release-curing polymerized butyl sealant complying with ASTM C1311 and formulated with minimum of seventy-five percent (75%) solids to be non-staining, paintable and have a tack-free time of 24 hours or less.
 - 1. "BC-158" Pecora Corp.
 - a. VOC content: 208 g/L.
 - 2. "Tremco Butyl Sealant" Tremco, Inc.
 - a. VOC content: 226 g/L.

2.05 PREFORMED FOAM SEALANTS

- A. Preformed Foam Sealants: Manufacturer's standard preformed; precompressed impregnated open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying water repellent agent; factory-produced in precompressed sizes and in a roll or stick form to fit joint widths indicated and to develop a watertight and airtight seal when compressed to the degree specified by manufacturer and complying with the following requirements:
1. Properties: Permanently elastic; mildew resistant, non-migratory, non-staining and compatible with joint substrates and other joint sealants.
 2. Impregnating Agent: Manufacturer's standard.
 3. Density: Manufacturer's standard.
 4. Backing: Pressure sensitive adhesive factory applied to one side with protective wrapping.
 5. Size: As determined by manufacturer.
 6. Products:
 - a. "Backerseal (Greyflex)" Emseal Corp.
 - b. Polyseal by Sandell Mfg. Co., Inc.

2.06 JOINT SEALANT BACKING

- A. General: Provide sealant backings of materials and type that are non-staining, are compatible with joint substrates, sealants, primers and other joint fillers, and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Plastic Foam Joint Fillers: Preformed, compressible, resilient, non-staining, non-waxing, non-extruding, strips of flexible plastic foam, of material indicated below and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
1. Closed-cell polyethylene foam rod, nonabsorbent to liquid, water and gas, non-outgassing in unruptured state.
 2. Open-cell polyurethane foam rod.
- C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape.

2.07 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer for adhesion of sealant to joint substrates indicated. All surfaces shall be primed.
- B. Cleaners for Non-Porous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable

of staining or harming in any way joint substrates and adjacent non-porous surfaces and formulated to promote optimum adhesion of sealants with joint substrates.

- C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and Project Condition.
- B. Verify that substrate surfaces and joint openings are ready to receive work.
- C. Verify that joint backing and release tapes are compatible with sealant.

3.02 PREPARATION

- A. Surface cleaning of joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete
 - b. Masonry
 - c. Unglazed surfaces of ceramic tile
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal
 - b. Glass
 - c. Glazed surfaces of ceramic tile
- B. Joint Priming: Prime joint substrates. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with

adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION

- A. Install sealant in accordance with manufacturer's printed instructions, except where more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications and conditions indicated.
- C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 - 1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - a. Do not leave gaps between ends of joint fillers.
 - b. Do not stretch, twist, puncture or tear joint fillers.
 - c. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
 - 2. Install bond breaker tape between sealants where backer rods are not used between sealants and joint fillers or back of joints.
- D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability to install sealants at the same time sealant backings are installed.
- E. Complete horizontal joints prior to vertical joints. Lap vertical sealant over horizontal sealant.
- F. Tooling of Non-Sag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, eliminate air pockets and ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - 1. Provide concave joint configurations per Figure 8A in ASTM C1193, unless otherwise indicated.
- G. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material and to comply with sealant manufacturer's directions for installation methods, materials and tools that produce seal continuity at ends, turns and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in conformance with sealant manufacturer's recommendations. **The joint sealer/expansion material shall be installed in strict accordance with manufacturer's**

instructions.

1. Surface preparation: Joint surfaces must be free from gross irregularities, loose particles, foreign matter such as dirt, dust, ice, snow, water and coatings such as grease, oil, release agents, lacquers that may be detrimental to the adhesion of the sealant.
2. Store materials inside at room temperatures, until ready for use.
3. Ensure material nominal size ordered matches field-measured, mean temperature joint size.
4. Remove shrink-wrap packaging, hardboard and self-adhesive release paper.
5. For Backerseal GreyFlex, cut 45 deg. miter where material will be joined

3.04 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion. If despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that the repaired installations are indistinguishable from original work.

3.05 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.06 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 1. Extent of Destructive Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform procedure every 100 linear feet in the first 1,000 linear feet of joint. If no test failure is observed in the first 1,000 linear feet of joint, perform procedure every 1,000 linear feet thereafter or approximately once per floor elevation.
 2. Test Method: Test joint sealants according to Method A, ASTM C1521.
 3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
 4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
 5. Repair sealants pulled from test area by applying new sealants following same

procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

JOINT SEALANT SCHEDULE

DESIGNATION	JOINT SEALERS	DESCRIPTION OF JOINT CONSTRUCTION AND LOCATION WHERE SEALANT IS TYPICALLY APPLIED.
ES-1	One-Part Neutral Cure Silicone Sealant	Not Used
ES-2	One-Part Neutral Cure Silicone Sealant	A. Exterior Joints in Vertical Surfaces at: 1. Brick expansion joints. 2. Perimeter joints between brick, and metal frames.
ES-3	One-Part Neutral Cure Silicone Sealant	A. Exterior Joints in Vertical Surfaces at: 1. Stone expansion/contraction joints 2. Joints between cast stone, stone and brick 3. Perimeter joints between cast stone, stone and metal frames 4. Joints between cast stone and stones
ES-4	One-Part Acid Curing Mildew-Resistant Silicone Sealant	Sealing around shower enclosures, sinks, urinals, bathroom fixtures, waterproofing rimless sinks
ES-5	Multi-Polyurethane	Traffic surface joints where joints exceed 5% slope.
ES-6	Multi-Polyurethane	Traffic surfaces where joints are on slopes 5% or less.
AES	Acrylic Sealant	Interior joints in field painted vertical and overhead surfaces, at perimeter of hollow metal frames, in gypsum drywall, in non-movement concrete block joints and all other joints not indicated otherwise.
SRC-S	Butyl Sealant	Bedding Thresholds.
Preformed Foam Sealant		As a secondary sealant used in conjunction with Sealant Joints ES-2 and ES-3, and at locations shown on the Drawings.

Sealants in contact
with fluid applied
membrane air barrier
and tapes per Section
07 27 26-Fluid- Applied
Membrane Air Barrier.

Refer to Section 07 27 26 for sealants
in contact with air barrier membrane and
tape.

ELASTOMERIC JOINT SEALANT DATA SHEET

ELASTOMERIC JOINT SEALANT DESIGNATION: ES-2 – General Weatherproofing

BASE POLYMER: Neutral – Curing Silicone Ultra Low-Modulus Silicone
TYPE: S – (Single Component)
GRADE: NS – (Non-Sag)
CLASS: 100/50
ADDITIONAL MOVEMENT CAPABILITIES: +100%/- 50%
USE RELATED TO EXPOSURE: NT – (Non-Traffic)
USES RELATED TO JOINT SUBSTRATES: M, G, A and applicable to “O” substrates listed
and/or G, A and applicable “O” substrates:

PRIMER: As recommended by sealant manufacturer for proper adhesion to joint substrate.

BACKER RODS: As recommended by sealant manufacturer, compatible with joint substrates, sealant, primer and other joint fillers.

COMPLIANCE:

1. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
2. Sealant – Waterproofing and Restoration Institute Sealant Validation.

ACCEPTABLE MANUFACTURER/PRODUCTS:

Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit a substitution according to conditions of the Contract and appropriate Division 1 sections.

1. Dow Corning; DOWSIL 790
 - a. VOC content: 23 g/L.
2. Pecora Corp.; 890 NST (Non-Staining Technology)
 - a. VOC content: 98 g/L.
3. Tremco Inc.; Spectrem 1
 - a. VOC content: 1 g/L.

ELASTOMERIC JOINT SEALANT DATA SHEET

ELASTOMERIC JOINT SEALANT DESIGNATION:

ES-3 – Weatherproofing Sensitive Porous Stone
(Cast Stone, Marble, Sandstone, Limestone,
Granite) and Metal Panels

BASE POLYMER: Neutral – Curing Silicone

TYPE: S – (Single Component)

GRADE: NS – (Non-Sag)

CLASS: 50

ADDITIONAL MOVEMENT CAPABILITIES: + 50%

USE RELATED TO EXPOSURE: NT – (Non-Traffic)

USES RELATED TO JOINT SUBSTRATES: G, M, A and applicable to “O” substrates listed:

PRIMER: As recommended by sealant manufacturer for proper adhesion to joint substrate

BACKER RODS: As recommended by sealant manufacturer, compatible with joint substrates, sealant, primer and other joint fillers.

COMPLIANCE:

1. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
2. ASTM C1248 – Standard Test Method for Staining of Porous Substrate by Joint Sealants.
3. Sealant – Waterproofing and Restoration Institute Sealant Validation.

ACCEPTABLE MANUFACTURER/PRODUCTS:

Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit a substitution according to conditions of the Contract and appropriate Division 1 sections.

1. Dow Corning; DOWSIL 756 SMS
 - a. VOC content: 86 g/L.
 - b.
2. Pecora Corp.; 895 NST (Non-Staining Technology)
 - a. VOC content: 98 g/L.
3. Tremco Inc.; Spectrem 3
 - a. VOC content: 18 g/L.

ELASTOMERIC JOINT SEALANT DATA SHEET

ELASTOMERIC JOINT SEALANT DESIGNATION:

ES-4 – Sealing Around Showers, Tubs, Sinks and Plumbing Fixtures

BASE POLYMER: Acid-Curing Silicone
TYPE: S – (Single Component)
GRADE: NS – (Non-Sag)
CLASS: 25

ADDITIONAL MOVEMENT CAPABILITIES:

USE RELATED TO EXPOSURE:

NT – (Non-Traffic)

USES RELATED TO JOINT SUBSTRATES:

G, A and O Substrates as listed:

PRIMER: As recommended by sealant manufacturer for proper adhesion to joint substrates.

BACKER RODS: As recommended by sealant manufacturer compatible with joint substrates, sealant, primer and other joint fillers.

COMPLIANCE:

1. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.

ACCEPTABLE MANUFACTURER/PRODUCTS:

Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit a substitution according to conditions of the Contract and appropriate Division 1 sections.

1. Dow Corning; DOWSIL 786 silicone mildew-resistant
 - a. VOC content: 22 g/L.
2. Pecora Corp.; 898 sanitary silicone
 - a. VOC content: 82 g/L.
3. Tremco Inc.; Tremsil 200
 - a. VOC content: 1 g/L.

ELASTOMERIC JOINT SEALANT DATA SHEET
ELASTOMERIC JOINT SEALANT DESIGNATION:

ES-5 – Traffic-Grade Sealant on
Slopes Between 5% and 12%

BASE POLYMER: Polyurethane
TYPE: M (Multi Component)
GRADE: NS – (Non-Sag)/P – (Pourable)
CLASS: 25, 50
ADDITIONAL MOVEMENT CAPABILITIES: + 25%
USE RELATED TO EXPOSURE: T (Traffic), I (Immersion)

USES RELATED TO POROUS JOINT SUBSTRATES: M, A and as applicable to “O” substrates indicated

SHORE A HARDNESS: 30-50

PRIMER: As recommended by sealant manufacturer for proper adhesion to joint substrate.

BACKER RODS/BOND BREAKER TAPE: As recommended by sealant manufacturer, compatible with joint substrates, sealant, primer and other joint fillers.

COMPLIANCE:

1. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
2. ASTM C661 – Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.

ACCEPTABLE MANUFACTURER/PRODUCTS:

Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit a substitution according to conditions of the Contract and appropriate Division 1 sections.

1. BASF, Sonneborn; Masterseal SL2 slope grade
 - a. VOC content: 93 g/L.
2. Pecora Corp.; Dynatred
 - a. VOC content: 114 g/L.
3. Tremco Inc.; Dymeric 240FC (Fast Cure)
 - a. VOC content: 5 g/L.

ELASTOMERIC JOINT SEALANT DATA SHEET
ELASTOMERIC JOINT SEALANT DESIGNATION:

ES-6 – Traffic-Grade Sealant on
Slopes 5% and Under

BASE POLYMER: Polyurethane
TYPE: M (Multi Component)
GRADE: NS – (Non-Sag)/P – (Pourable)
CLASS: 25, 50
ADDITIONAL MOVEMENT CAPABILITIES: + 25%
USE RELATED TO EXPOSURE: T (Traffic)

USES RELATED TO POROUS JOINT SUBSTRATES:

M, A and as applicable to “O” substrates
indicated

SHORE A HARDNESS: 30-50

PRIMER: As recommended by sealant manufacturer for proper adhesion to joint substrate.

BACKER ROD/BOND BACKER TAPE: As recommended by sealant manufacturer, compatible
with joint substrates, sealant, primer and other joint fillers.

COMPLIANCE:

1. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
2. ASTM C661 – Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer.

ACCEPTABLE MANUFACTURER/PRODUCTS:

Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit a substitution according to conditions of the Contract and appropriate Division 1 sections.

1. BASF, Sonneborn; Masterseal SL2
 - a. VOC content: 93 g/L.
2. Pecora Corp.; Urexpan NR-200
 - a. VOC content: 20 g/L.
3. Tremco Inc.; Dymeric 240FC (Fast Cure)
 - a. VOC content: 5 g/L.

END OF SECTION

SECTION 08 11 16 – INTERIOR ALUMINUM FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Related Documents:

1. Provisions established within the General and Supplementary Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

B. Section includes interior aluminum frames designated as AL on Drawings for:

1. Aluminum sliding frame systems.
2. Aluminum and glass doors.
3. Aluminum office-front framing system for interior use.

C. Related Sections:

1. Section 08 14 16 – Flush Wood Doors.
2. Section 08 71 00 - Door Hardware.
3. Section 08 80 00 - Glazing.

1.02 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Product Data: Submit for door, sliding frames and office-front frames.

1. Include information for factory finish, glazing gaskets, accessories and other required components.
2. Include color charts for finish indicating manufacturer's standard colors available for selection.

C. Shop Drawings: Submit schedule indicating opening identification number, frame types, dimensions, and hardware requirements. Use same reference numbers for openings as Contract Drawings.

D. Include elevations and details indicating frame types, profiles, conditions at openings, methods and locations of anchoring, glazing requirements, hardware locations, and reinforcements for hardware, details of connections to special construction and other custom features.

E. Samples: Submit following:

1. Samples indicating quality of finish in selected colors on alloys used for Work.

2. Where normal color and texture variations are expected, include additional samples to show range of such variation.

F. Informational Submittals: Submit manufacturer's instructions.

1.03 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide aluminum frames, aluminum and glass doors, and accessories produced by a single manufacturer for each type of product indicated.
- B. Manufacturer's Qualifications: Manufacturer shall demonstrate previous experience in manufacturing of interior aluminum door and office-front framing for a period of not less than 10 years on comparable sized project.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver frames and doors in cartons to provide protection during transit and storage at project site.
- B. Inspect frames and doors upon delivery for damage.
 1. Repair minor damage to pre-finished products by means as recommended by manufacturer.
 2. Replace frames and doors that cannot be satisfactorily repaired.
- C. Store frames and doors at project site under cover and as near as possible to final installation location. Do not use covering material that will cause discoloration of aluminum finish.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Do not begin installation of frames or doors until area of work has been completely enclosed and interior is protected from the elements.
- B. Maintain temperature and humidity in areas of installation within reasonable limits, as close as possible to final occupancy. If necessary, provide temperature control and ventilation to maintain required environmental conditions.

1.06 WARRANTY

- A. Warrant against defects in manufacturing of materials for a period of 2 years from date of substantial completion.
- B. Warrant framing finish against defects, including cracking, flaking, blistering, peeling and excessive fading, chalking and non-uniformity in color for a period of 5 years.
- C. Warrant aluminum and glass doors for the life of door against construction failure, causing wracking of door beyond acceptable tolerances.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS AND PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change concept as expressed in Contract Documents as judged by Architect. Manufacturers not named may submit as substitutions according to Conditions of the Contract and appropriate Division 1 sections.
 - 1. Raco Interior Products, Inc.: Raco Interior Office Fronts, Solutions II.
 - a. Interior Office-Front Framing: RACO Solutions II OfficeFronts, fixed throat frames to accommodate wall thicknesses indicated on Drawings; with applied full face trim of 2 inch width.
 - 2. Flush sliding cased opening frames with attached sidelights or OfficeFronts: Solutions II.
 - 3. Sliding aluminum and glass doors: Raco Series 400 medium stile, having square glazing stops, black EDPM glazing gaskets.

2.02 MATERIALS

- A. Aluminum: Meeting requirements of ASTM B221, 6063T5 alloy, and as otherwise required to assure compliance with dimensional tolerances and maintain color uniformity. Billets shall be composed of at least 33 percent recycled aluminum.
- B. Anchorage Devices, Clips and Fasteners: Manufacturer's standard type, compatible with materials being secured.
- C. Accessories: As necessary for complete system.
- D. Top load glazing gaskets, black for 1/4 inch glass. Refer to Section 08 80 00 Glazing for glass.

2.03 EXTRUDED ALUMINUM FRAME AND DOOR FABRICATION

- A. Utilize reduced profile corner section for 90-degree corners.
- B. Assemble all door frames, sidelights, and window units with screws utilizing internal screw spline system, insert into the drywall rough opening.
- C. Assemble all sidelights and windows without the use of clips.
- D. Do not exceed maximum size of window or door to meet applicable code requirements.
- E. Factory pre-machine door frame jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required, and fastened within frame with concealed screws.
- F. Manufacturer shall precut and predrill for screw spline joinery. Butt cut snap on trim casings shall be furnished in stock lengths.

2.04 FINISHES

- A. Factory finish extruded frame and door components so that all parts exposed to view upon completion of installation are uniform in finish and color. Exposed surfaces shall be free of scratches and other serious blemishes.
- B. Clear Anodized: Class II AAMA 611 AA-M12C22A31, acid etched, medium matte, clear anodic coating, 0.4 mil thickness – 0.7 mil thickness.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine project conditions and verify that project is ready for work of this section to proceed. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Verify wall thickness does not exceed manufacturer's recommended tolerances of specified throat size.

3.02 INSTALLATION

- A. Comply with frame and door manufacturer's printed installation instructions and approved Shop Drawings. Do not attempt installation in areas where wall thickness exceeds tolerances of specified throat size.
- B. Install frames plumb and square, free from warp or twist, securely anchored to substrates with fasteners recommended by frame manufacturer. Maintain dimensional tolerances and alignment with adjacent work. Ensure joints are hairline tight and surfaces flush with adjacent components.
- C. Set all frames in correct locations as shown on the drawings, level, square, plumb and in alignment with other work in accordance with the manufacturer's installation instructions and approved Shop Drawings.
- D. Install glass in accordance with Section 08 80 00.

3.03 ADJUSTING AND CLEANING

- A. Protect exposed portions of aluminum surfaces from damage by plaster, lime, acid, cement, and other contaminants.
- B. Touch up marred areas so that touch-up is not visible from a distance of 4 feet. Remove and replace frames that cannot be satisfactorily adjusted.

3.04 PROTECTION

- A. Protect as required to assure that frames and doors will be without damage until Substantial Completion.

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Interior Aluminum Frames
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END OF SECTION

SECTION 08 12 14 – STANDARD STEEL FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. This Section Includes:

1. Non-Rated Frames.
 - a. Door frames.
 - b. Pocket door frames.

B. Related Sections:

1. Section 08 13 14 – Standard Steel Doors.
2. Section 08 14 16 – Flush Wood Doors.
3. Section 08 71 00 – Door Hardware.
4. Section 09 22 16 – Non-Structural Metal Framing: Securing steel frames to metal studs.
5. Section 09 90 00 – Painting and Coating.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI/DHI A115 – Specifications for Hardware Preparations in Standard Steel Doors and Frames.
2. ANSI/DHI A115.1G – Installation Guide for Doors and Hardware.
3. ANSI A250.3 – Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
4. ANSI A250.4 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
5. ANSI A250.6 – Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
6. ANSI A250.7 – Nomenclature for Steel Doors and Steel Frames.
7. ANSI A250.8-SDI-100 – Recommended Specifications for Standard Steel Doors and Frames; 2017 (R2014).
8. ANSI A250.11 – Recommended Erection Instructions for Steel Frames (Formerly SDI-105).

B. ASTM International:

1. ASTM A568 – Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
 2. ASTM A591 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 3. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 4. ASTM A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 5. ASTM A1008 – Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- C. SDI – Steel Door Institute:
1. SDI 111 – Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.
 2. SDI 112 – Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames.
 3. SDI 117 – Manufacturing Tolerances for Standard Steel Doors and Frames.
 4. SDI 122 – Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
 5. SDI 124 – Maintenance of Standard Steel Doors and Frames.

1.03 SUBMITTALS FOR REVIEW

- A. Section 01 33 00 – Submittal Procedures: Procedures for submittals.
- B. Product Data: Indicate frame configuration and finishes.
- C. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacings, location of cut-outs for hardware, and finish.
- D. Certificates: Product certificates signed by manufacturer certifying material compliance with specified requirements.
- E. Installation Instructions: Manufacturer's printed installation instructions.

1.04 QUALITY ASSURANCE

- A. Conform to requirements of ANSI A250.8-2017.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years of documented experience.

1.06 DELIVERY, STORAGE AND PROTECTION

- A. Section 01 60 00 – Product Requirements: Transport, handle, store and protect products.
- B. Accept frames on site in manufacturer's packaging. Inspect for damage.
- C. Frames shall be stored under cover on 4" wood sills on floors in a manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters, which create humidity and promote rusting. Frames shall be stored in a vertical position, five units maximum in a stack. Provide 1/4" space between frames to promote air circulation.

1.07 PROJECT CONDITIONS

- A. Section 01 30 00 – Administrative Requirements: Coordination and Project Conditions.
- B. Coordinate the work with frame opening construction, door and hardware installation.
- C. Sequence installation to ensure wire connections are achieved in an orderly and expeditious manner.

PART 2 PRODUCTS

2.01 FRAME MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers listed below. If not named, submit as a substitution according to Conditions of the Contract and appropriate Division 1 sections.
 - 1. Ceco Door/Assa Abloy.
 - 2. Curries Company/Assa Abloy.
 - 3. Steelcraft.

2.02 MATERIALS

- A. Frames and frame anchors for each of the levels and models specified shall be provided to meet the requirements of the performance levels specified. The material used in manufacturing these products and components shall comply with ANSI A250.8. Hardware reinforcing on frames shall comply with ANSI A250.6. The physical performance levels shall be in accordance with ANSI A250.4.
- B. Cold-rolled steel shall conform to ASTM designations A1008 – Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and ASTM A568 – Standard Specification for Steel Sheet, Carbon and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
- C. Hot-dipped, zinc-coated steel shall be of the alloyed type and comply with ASTM designations A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process and ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the

Hot-Dip Process.

2.03 FRAMES

- A. Provide metal frames for doors, transoms, sidelights, transom/sidelight frames, windows (borrowed lights) and other openings, according to ANSI A250.8-2017 (R2014), and of types and styles as shown on Drawings and schedules. Conceal fastenings, unless otherwise indicated.
 - 1. Interior Frames:
 - a. Material: Cold-rolled steel steel conforming to ASTM A1008 and ASTM A568.
 - b. Minimum material thickness prior to coating: 0.053 inches (16 gauge).
 - 2. Interior Pocket Door Frames:
 - a. Material: Cold-rolled steel steel conforming to ASTM A1008 and ASTM A568.
 - b. Minimum material thickness prior to coating: 0.053 inches (16 gauge).
 - 3. Exterior Frames:
 - a. Material: Hot-dipped zinc-iron alloy-coated galvanized steel conforming to ASTM A653, coating designation A60.
 - b. Minimum material thickness prior to coating: 0.067 inches (14 gauge).
- B. Door Silencers: Except on weatherstripped frames drill stops to receive 3 silencers on strike jambs of single-door frames and 2 silencers on heads of double-door frames.
- C. Plaster Guards: Provide minimum 0.0179 inch thick steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.
- D. Reinforce frames over 48 inches with rolled formed steel channels fitted tightly into frame head, flush with top.

2.04 FABRICATION

- A. Corner joints shall have all contact edges closed tight with faces mitered and stops either butted or mitered.
 - 1. Welded Frames: Full profile welded, also specified as fully welded or continuously welded.
 - a. Weld miter joints between head and jamb faces completely along their length either internally or externally.
 - b. Internally weld perimeter profile joints full length of soffit stops and rabbets with hairline seams on external meeting surfaces. Grind and finish face joints smooth.
 - c. Face joints at meeting mullions or between mullions and other frame members shall be completely externally welded on the faces only. All welds shall be ground and finished smooth.

2. Welded frames shall be provided with two temporary steel spreader bars, welded to the jambs at each rabbet of door openings, for shipping and handling purposes only. These temporary spreader bars shall be removed and setting spreaders, supplied by the installer shall be used for installation of the frame. Refer to ANSI A250.11 – Recommended Erection Instructions for Steel Frames.
 3. Pocket door frames shall be knocke down. KD.
- B. Fabricate jambs, and heads straight and uniform throughout their lengths; square and free of defects, warps or buckles.
- C. Fabricate frames with hardware reinforcement plates welded in place. Provide mortar guard boxes.
- D. Prepare frames for silencers. Provide three single silencers for single doors on strike side. Provide two single silencers on frame head at double doors without mullions.
- E. When shipping limitations or site access so dictate, or when advised by the contractor responsible for coordination or installation, frame product for large openings shall be fabricated in sections designated for assembly in the field by others. Alignment plates or angles shall be installed at each joint. Such components shall be the same material and thickness as the frame. Field joints shall be made in accordance with approved Submittal Drawings and shall be field welded by others.
- F. Floor Anchors:
1. Floor anchors shall be provided with two holes for fasteners and shall be secured inside jambs with at least four (4) spot welds per anchor.
 2. Where specified or scheduled, adjustable floor anchors, providing not less than 2 in. (50.8 mm) height adjustment, shall be fastened in place with at least four (4) spot welds per anchor.
 3. For applications that do not permit the use of a floor anchor, an additional jamb anchor shall be substituted at a location not to exceed 8 in. (204 mm) from the base of the jamb.
 4. Floor anchor shall be of same material and thickness as frame.
- G. In cases where electrically or electronically operated hardware is required and indicated on the approved hardware schedule, conduit, hardware enclosures and/or junction boxes shall be provided. Access plates, where required, shall be the same material and thickness as the frame product and shall be fastened with not less than four (4) #8-32 machine screws or #6 sheet metal screws at a spacing not to exceed 12 inc. on center.
- H. Tolerances:
1. Face Widths, Door Stop Heights and Jamb Depths: 0.031 inch.
 2. Throat Openings: 0.063 inch.
 3. Door Rabbets: 0.016 inch.

2.05 FINISHING

A. Steel:

1. Remove weld slag and splatter from exposed surfaces.
2. Fill and sand all tool marks, abrasions and surface blemishes to present smooth uniform surfaces.
3. On exposed surfaces where zinc-iron alloy coating has been removed during fabrication, factory apply rust inhibitive touch-up primer.
4. Fully cure primer prior to shipment.

2.06 SHOP PRIMER

- A. Prime Finish: Frames shall be thoroughly cleaned, and chemically treated to insure maximum paint adhesion. All surfaces of the frame exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on. The finish shall meet the requirements for acceptance stated in ANSI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."
- B. Apply primers to frames after fabrication. Coordinate primer with field-applied finish coatings as specified in Section 09 90 00 for compatibility, with finish coats.

2.07 HARDWARE PREPARATION

- A. Prepare frames for hardware specified elsewhere; comply with DHI A115 series standards; adjust locations to allow for specified clearances and size tolerances, with maximum variation from template dimensions of plus 0.015 inch and minus 0.
- B. Fully Templated Mortise Hardware: Factory blank, reinforce, drill and tap frames in accordance with approved shop drawings and templates provided by hardware supplier.
 1. Factory prepare templated holes 0.5 inch diameter and larger, except mounting and through bolt holes.
 2. Factory prepare templated holes less than 0.5 inch diameter when required for the function of the device (for knobs, levers, cylinders, thumb or turn pieces) or when these holes over-lap function holes.
- C. Mortised Hardware Not Fully Templated: Factory blank and reinforce frames; drill and tap on site.
- D. Reinforce frames in accordance with Table 4 of ANSI A250.8-2017 (R2014).

2.08 FRAME ANCHORAGE

- A. Frame Anchors: Provide anchors appropriate to floor, wall and frame construction.
 1. Provide fasteners, anchor bolts, and expansion shell anchors as required.
- B. Standard Frames:

1. Dry Wall Type:
 - a. Frame product for installation in dry-wall partitions shall be provided with steel stud jamb anchors of suitable design, not less than 0.042 in. thickness, securely welded inside each jamb. Jamb anchors shall be placed a maximum of 18 in. from top and bottom of openings. The minimum number spaced at maximum 32 in. on center, near hinges and directly opposite on strike jambs, provided on each jamb, based on the overall frame height, shall be as follows:
 - 1) Up to 60 in.: 3 anchors.
 - 2) Greater than 60 in. up to 90 in.: 4 anchors.
 - 3) Greater than 90 in. up to 96 in.: 5 anchors.
 - 4) Greater than 96 in.: 5 anchors plus one for each 24 in. or fraction thereof, spaced at 24 in. maximum between anchors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.

3.02 INSTALLATION

- A. General: Install steel frames and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions of ANSI A250.11 and DHI A115.IG, unless otherwise indicated.
- C. Set frames plumb, square, aligned, without twist and at correct elevation, within the following tolerances:
 1. Plumbness: Not more than 0.063 inch out of plumb, measured using a line from the intersection of vertical members and the head to the floor.
 2. Squareness: Not more than 0.063 inch difference between diagonal measurements between corners.
 3. Alignment: Not more than 0.063 inch measured on jambs, through a horizontal line parallel to the plane of the wall.
 4. Twist: Not more than 0.063 inch measured at face corners of jambs, on parallel lines perpendicular to the plane of the wall.
- D. Brace frames rigidly in position while partitions are being constructed.
 1. Remove temporary steel shipping jamb spreaders.
 2. Install wood spreaders at mid-point of frame rabbet height to maintain frame widths.

3. Provide vertical support at center of head for openings exceeding 48 inches in width.
4. Remove wood spreaders after product has been built-in.
- E. Place frames before constructing enclosing walls and ceilings.
- F. Secure anchorages and connections to adjacent construction.
- G. Install hardware in accordance with ANSI A115.IG, manufacturer's templates and instructions.
- H. Keep steel surfaces free of grout, tar, other bonding materials, and sealers; clean surfaces immediately following installation.
- I. Install door silencers; coordinate with field painting to avoid unnecessary masking or cleaning.
- J. Touch up damaged surfaces and exposed field welds with rust inhibitive primer:
 1. Prepare galvanized steel to be finished with latex paints by cleaning with soap and water to remove foreign matter.
 2. Prepare galvanized steel to be finished with alkyd paints by cleaning with turpentine or paint thinner.
 3. Finish exposed field welds to present a smooth uniform surface.
 4. Follow recommendations of final paint finish manufacturer.
- K. Damaged work will be rejected and shall be replaced at no additional cost to the owner.
- L. Coordinate installation of frames with hardware specified in Section 08 71 00 and doors in Section 08 13 14 and Section 08 14 16.

3.03 ADJUSTING

- A. Adjust operable parts for correct clearances and function.
- B. Adjust hinge sets, locksets and other hardware. Lubricate using a suitable lubricant compatible with door and frame coatings.

3.04 CLEANING AND PROTECTION

- A. Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer's instructions before Owner's acceptance.
- B. Remove from project site and legally dispose of construction debris associated with this work.
- C. Protect installed products and finished surfaces from damage during construction.

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END OF SECTION

SECTION 08 13 14 – STANDARD STEEL DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-rated steel doors.

1.02 RELATED SECTIONS

- A. Section 08 12 14 – Standard Steel Frames.
- B. Section 08 71 00 – Door Hardware.
- C. Section 09 90 00 – Painting and Coating: Field painting of doors.

1.03 REFERENCES

- A. American National Standards Institute:

1. ANSI/DHI A115 – Specifications for Hardware Preparation in Standard Steel Doors and Frames.
2. ANSI/DHI A115.1G – Installation Guide for Doors and Hardware.
3. ANSI A250.3 – Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames.
4. ANSI A250.4 – Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings.
5. ANSI A250.6 – Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
6. ANSI A250.8 – SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2017 (R2014).
7. ANSI A250.10 – Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
8. ANSI A250.11 – Recommended Erection Instructions for Steel Frames (Formerly SDI-105).

- B. ASTM International:

1. ASTM A568 – Standard Specification for Steel Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
2. ASTM A591 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized)

or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

4. ASTM A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 5. ASTM A1008 – Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 6. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
- C. SDI – Steel Door Institute:
1. SDI 111 – Recommended Details and Guidelines for Standard Steel Doors and Frames and Accessories.
 2. SDI 112 – Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames.
 3. SDI 117 – Manufacturing Tolerances for Standard Steel Doors and Frames.
 4. SDI 122 – Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
 5. SDI 124 – Maintenance of Standard Steel Doors and Frames.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate door elevations, internal reinforcement, closure method, and finish. Provide schedule of doors and frames using the same reference numbers for details and openings as those on the Drawings.
- C. Product Data: Indicate door configurations, location of cut-outs for hardware reinforcement.
- D. Manufacturer's Installation Instructions: Indicate special installation instructions.
- E. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Provide doors complying with ANSI A250.8-2017 (R2014). "Recommended Specifications for Standard Steel Doors and Frames" as specified, and other specifications herein named.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years of documented experience.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Inspect doors upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to architect; otherwise, remove and replace damaged items as directed.
- C. Store doors at building site under cover. Place units on minimum 4-inches-high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4-inch spaces between stacked doors to promote air circulation.

1.08 COORDINATION

- A. Coordinate with door opening construction and door frame and door hardware installation.
- B. Coordinate installation to accommodate door hardware electric wire connections.

PART 2 PRODUCTS

2.01 DOOR MANUFACTURERS (STANDARD STEEL DOORS)

- A. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers listed below. If not named, submit as a substitution according to Conditions of the Contract and appropriate Division 1 sections.
 - 1. CECO Door/Assa Abloy.
 - 2. Curries Company/Assa Abloy.
 - 3. Steelcraft.

2.02 MATERIALS

- A. Doors and hardware reinforcements for each of the levels and models specified shall be provided to meet the requirements of the performance levels specified. The material used in manufacturing these products and components shall comply with ANSI A250.8. Hardware reinforcing on doors and frames shall comply with ANSI A250.6. The physical performance levels shall be in accordance with ANSI A250.4.

2.03 DOORS

- A. Steel Doors: Provide 1-3/4-inch-thick doors of materials and ANSI A250.8-2017 (R2014) for grades and models specified below.

1. Exterior doors shall meet the following requirements:
 - a. Level: Level 3, extra-heavy-duty.
 - b. Model: Model 2 – Seamless welded construction.
 - c. Physical performance level: Level A, 1,000,000 cycles.
 - d. Thickness: 0.053 inches (16 gauge).
 - e. Material: Hot-dipped zinc-iron alloy-coated galvanized steel conforming to ASTM A653.
 - 1) Coating designation: A60.
- B. Hot-dipped zinc-coated steel shall be of the alloyed type and comply with ASTM designations A924 – Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process and A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot-Dip Process.

2.04 FABRICATION

- A. Fabricate steel doors to be rigid, neat in appearance and free from defects, warp, or buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site. Comply with ANSI A250.8 requirements.
 1. Internal Construction:
 - a. Vertical steel stiffeners with foamed in place polyurethane insulation chemically bonded to all interior surfaces.
 - b. Basis of Design: Curries ASSA ABLOY 777E or approved equal.
 - 1) Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 0.026 in. minimum thickness, spaced so that the vertical interior webs shall be no more than 6 in. apart and securely fastened to both face sheets by spot welds spaced a maximum of 5 in. o.c. vertically. Spaces between stiffeners shall be filled with foamed in place polyurethane insulation chemically bonded to all interior surfaces.
 - 2) Assembly U value with standard frame: 0.41.
 - 3) Assembly R value with standard frame: 2.44.
 2. Design clearances: Fabricate doors and frames to maintain the following clearances:
 - a. The clearance between the door and frame shall be 1/8 inch (3.2 mm) in the case of both single swing and pairs of doors.
 - b. The clearance between the meeting edges of pairs of doors shall be 3/16 inch (4.8 mm) plus or minus 1/16 inch (1.6 mm).
 - c. The clearance measured from the bottom of the door to the bottom of the frame (undercut) shall be a maximum of 3/4 inch (19.1 mm) unless otherwise specified.
 - d. The clearance between the face of the door and the stop shall be 1/16

- inch (1.6 mm) to 3/32 inch (2.4 mm).
- e. All clearances shall be, unless otherwise specified in this document, subject to a tolerance of plus or minus 1/32 inch (0.8 mm).
- 3. Top and Bottom End Closure: Channel 0.053 inch thick inverted unless noted otherwise.
 - 4. Door Edge Design: Provide in accordance with ANSI/SDI A250.8. Provide manufacturer's standard edge.
- B. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames."
 - C. Fabricate concealed stiffeners, reinforcement, edge channels, from either cold-or hot-rolled steel sheet.
 - D. Hot-Dipped Galvannealed Steel Doors and Panels: For the following locations, fabricate doors and panels from galvannealed steel sheet according to SDI 112, galvannealed to ASTM A924 and A653, A60. Close top and bottom edges of doors flush as an integral part of door construction or by addition of minimum 0.053 inch galvannealed steel channels, with channel webs placed even with top and bottom edges. Seal joints in top edges of doors against water penetration. Include galvannealed components and internal reinforcements.
 - 1. At all exterior locations.
 - E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
 - F. Hardware Preparation: Prepare doors to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements of SDI 107 and ANSI A115 Series specifications for door and frame preparation for hardware.
 - G. Reinforce doors to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at Project site.
 - 1. Minimum hardware reinforcing gages shall comply with Table 4 of ANSI A250.8-2017 (R2014).
 - H. Locate hardware as indicated on Shop Drawings or, if not indicated, according to the Door and Hardware Institute's (DHI) "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

2.05 PRIMER

- A. Prime Finish: Doors shall be thoroughly cleaned, and chemically treated to insure maximum paint adhesion. All surfaces of the door exposed to view shall receive a factory applied coat of rust inhibiting primer, either air-dried or baked-on. The finish shall meet the requirements for acceptance stated in ANSI A250.10 "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

- B. Field-Applied Finish Paint
 - 1. Coordinate primer with field applied finish coatings as specified in Section 09 90 00 for compatibility with finish coats.
 - a. Furnish painting contractor with manufacturer's literature for description of primer used.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Install steel doors and accessories according to Shop Drawings, manufacturer's data and as specified.
 - 1. Doors shall be installed in accordance with ANSI/DHI A115.1G.
- B. Door Installation: Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8.
- C. Coordinate installation of doors with installation of frames specified in Section 08 12 14 and hardware specified in Section 08 71 00.
- D. Damaged work will be rejected and shall be replaced at no additional cost to the Owner.

3.02 ADJUSTING AND CLEANING

- A. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 08 14 16 – FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes the following flush wood doors, non-rated:
 - 1. Solid core doors with plastic laminate faces.
 - 2. Factory finishing of flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.02 RELATED SECTIONS

- A. Section 08 11 16- Interior Aluminum Frames.
- B. Section 08 12 14 – Standard Steel Frames.
- C. Section 08 71 00 – Door Hardware.

1.03 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A115 – W Series, Wood Door Hardware Standards.
- B. Door and Hardware Institute:
 - 1. DHI-WDHA-3 – Recommended Hardware Locations for Wood Doors.
- C. National Electrical Manufacturers Association:
 - 1. NEMA LD3 – High Pressure Decorative Laminates.
- D. Window and Door Manufacturers Association:
 - 1. ANSI/WDMA 1.S.1A-13 – Industry Standard for Architectural Wood Flush Doors.

1.04 SUBMITTALS FOR REVIEW

- A. Section 01 33 00 – Submittals: Procedures for submittals.
- B. Product Data: For each type of door indicate details of core and edge construction, and factory-finishing specifications.
- C. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, and factory finishing criteria.
- D. Construction Samples: Submit four samples of door construction, 5 by 5 inch in size, cut

from top corner of door.

- E. Finishing Samples: Submit a set of 3 illustrating the range of color and grain of the specified door face material, minimum 6 x 6 inch in size illustrating:
 - 1. Plastic laminate door faces: Color, texture and pattern.
- F. Manufacturer's full lifetime warranty.

1.05 SUBMITTALS FOR INFORMATION

- A. Section 01 33 00 - Submittals: Procedures for submittals.
- B. Manufacturer's Installation Instructions: Indicate special installation instructions.

1.06 QUALITY ASSURANCE

- A. Quality Standard: Comply with the following standard:
 - 1. Meet or exceed ANSI/WDMA 1.S.1 A-13 Industry Standard for Architectural Wood Flush Doors.
- B. Single-Source Responsibility: Obtain doors from one source and by a single manufacturer.

1.07 DELIVERY, STORAGE AND PROTECTION

- A. Section 01 60 00 – Product Requirements: Transport, handle, store and protect products.
- B. Deliver, store, protect and handle products under provisions of WDMA and manufacturer's care and handling instructions.
- C. Store doors flat on a level surface in a dry, well-ventilated building. Doors shall be kept at least 4 inches off the floor and shall have protective coverings under the bottom door and over the top. Covering shall protect doors from dirt, water and abuse, and shall allow for air circulation under and around the stack.
- D. Doors shall not be exposed to direct light (artificial or natural). Wrap individual doors with opaque wrapping.
- E. Do not subject doors to extremes of heat and or humidity. Do not allow doors to come in contact with water. HVAC systems shall be operational and balanced, providing a temperature range of 50 to 90 degrees F and 30% to 50% relative humidity.
- F. Do not install doors in buildings with wet plaster or cement.
- G. When handling doors, always lift and carry. Do not drag across other doors or surfaces.
- H. Each door shall be marked on top rail with door opening number.

1.08 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.
- B. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during the remainder of the construction period to comply with the following requirements applicable to Project's geographical location:
 - 1. Deliver, store, protect and handle products under provisions of WDMA and manufacturer's care and handling instructions.

1.09 WARRANTY

- A. General Warranty: Door manufacturer's warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by manufacturer, Installer, and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) more than 1/4 inch in a 42-by-84-inch section or that show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span, or do not conform to tolerance limitations of referenced quality standards.
 - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors where defect was not apparent prior to hanging.
 - 2. Warranty shall be in effect during the following period of time after date of Substantial Completion.
 - a. Solid Core Interior Doors: "Full Life of Original Installation."

PART 2 PRODUCTS

2.01 MANUFACTURERS/PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a Standard of Quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change concept as expressed in Contract Documents as judged by Architect.
 - 1. Basis of Design, Plastic Laminate Wood Doors:
 - a. Manufacturer/Product: Masonite Architectural, Aspiro Series | Marshfield-Algoma, Interior Solid Core Flush Laminate-Faced (HPDL) Doors – Choice Laminate.
 - 1) Non-rated: Aspiro Series, Structural Composite Lumber, No added Urea-Formaldehyde, FSC Certified (extra heavy-duty performance level), Model A-SCLC-B-NR.

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers below. If not named, submit as substitution according to Conditions of the Contract and appropriate Division 1 section.

1. Eggers Industries, Architectural Door Division.
2. VT Industries.

2.02 WORKMANSHIP

A. Comply with ANSI/WDMA 1.S.1A-13.

2.03 PERFORMANCE STANDARD

A. Comply with ANSI/WDMA I.S. 1A-13 Extra Heavy Duty, Performance Duty Level.

B. Cross band required to meet ANSI/WDMA 1.S 1A-13 required performance duty level.

2.04 DOOR TYPES (PLASTIC LAMINATE)

A. Door designation per ANSI/WDMA 1.S.1A-13.

B. Flush Interior Doors (Non-Rated): SCLC-HPDL-5, Environmental Structural Composite Lumber Core Door with decorative laminate each side (5-ply), 1-3/4 inches thick.

2.05 FABRICATION

A. Door Core Construction: Comply with the following requirements:

1. Non-Rated: Extra Heavy Duty Performance Level Environmental Structural Composite Lumber Core.
2. Bond stiles and rails to core, abrasive sand core assembly to achieve uniform thickness before veneering.

B. Vertical Edges (Stiles)

1. Non-Rated (Plastic Laminate):
 - a. Manufacturer's standard laminated hardwood edge or SCL.
 - b. Edges, same laminate as door facing, applied after face.
 - c. Joints: No joints allowed.

C. Horizontal Edge (Rails)

1. Mill option structural composite lumber or hardwood lumber.

D. Adhesive:

1. Type I or Type II.

E. Machining for non-rated doors:

1. Factory fit and machine doors for frames and finish hardware in accordance with hardware requirements and dimensions.

F. Plastic laminate:

1. Colors, Patterns and Finishes: As indicated on list of finishes.
2. Faces: NEMA LD-3, HGS (nominal 0.048 inch) high-pressure decorative laminate.

2.06 FABRICATION

A. Fabricate flush wood doors to comply with following requirements:

1. Factory fit doors to suit frame-opening sizes Indicated, with the following uniform clearances and bevels:
2. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3 recommended hardware locations for wood flush doors. Comply with final hardware schedules, door frame Shop Drawings, ANSI A115.W Series Standards and hardware templates.
 - a. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory machining.

2.07 FACTORY FINISHING

- A. General: Comply with ANSI/WDMA 1.S.1A-13 standard's requirements for factory finishing.
- B. Finish wood doors at factory.
- C. Plastic Laminate: As specified.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine installed door frames prior to hanging door:
 1. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and have been installed with plumb jambs and level heads.
 2. Reject doors with defects.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Hardware: For installation see Section 08 71 00 – Door Hardware.
- B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions

and referenced quality standard and as indicated.

- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Laminated Doors: Restore finish before installation, if fitting or machining is required at the job site.
- E. Do not install doors until the HVAC system is operating.

3.03 ADJUSTING AND PROTECTION

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Refinish or replace doors damaged during installation.
- C. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at the time of Substantial Completion.

END OF SECTION

SECTION 08 31 13 – ACCESS DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-rated access doors.
- B. Provide for access to controls, valves, traps, dampers, cleanouts and similar items requiring operation behind inaccessible finished surfaces.
- C. Coordinate exact locations with various trades to assure proper placement of access doors and panels.

1.02 RELATED SECTIONS

- A. Section 09 90 00 – Painting and Coating: Field paint finish.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Section 01 33 00 – Submittal Procedures.
 - 1. Product data in form of manufacturer's technical data and installation instructions for each type of access door assembly, including setting Drawings, templates, instructions and directions for installation of anchorage and devices.

1.04 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain access doors for entire project from one source from a single manufacturer.
- B. Size Variations: Obtain Architect/Engineer acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.
- C. Coordination: Furnish inserts and anchoring devices that must be built into other work for installation of access doors. Coordinate delivery with other work to avoid delay.

1.05 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Requirements for coordination.
- B. Verification: Obtain specific locations and sizes for required access doors from trades requiring access to concealed equipment, and indicate on submittal schedule.

1.06 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of access units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Contract Documents are based on manufacturer and products named below to establish a Standard of Quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change concept as expressed in Contract Documents as judged by Architect.

1. Basis of Design Selections:

- a. Manufacturer: Milcor Inc.
- b. Products:

1) Access Door Style "DW"

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit as substitution according to Conditions of the Contract and appropriate Division 1 sections.

- 1. Larsens Manufacturing Company.
- 2. Nystrom Building Products.

2.02 ACCESS UNITS – GYPSUM BOARD WALLS AND CEILINGS

A. At gypsum board openings: Milcor Access Door Style "DW":

- 1. 3203-014, Door size 14 inches by 14 inches.
- 2. 3203-019, Door size 24 inches by 24 inches.
- 3. 3203-036, Door size 24 inches by 36 inches.

B. Fabrication:

- 1. Fabricate frames of 16-gauge steel.
- 2. Fabricate door panels of 16-gauge steel.
- 3. At drywall access doors provide galvanized drywall bead.
- 4. Weld, fill, and grind joints to assure flush, square unit.
- 5. Hardware:
 - a. Hinges: Double-acting concealed spring type.
 - b. Locks: Key-operated cylinder lock with two keys.

2.03 FINISHES

A. Base Metal Protection: Prime coat units with baked on primer for wall and ceiling units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Ensure that rough openings for door and frame are correctly sized and located.

3.02 LOCATION

- A. Coordinate with plumbing and HVAC Drawings for equipment which requires access. Items which require access include, but are not limited to, valves, traps, drains, and cleanouts. Refer to Schedule at the end of this Section.

3.03 INSTALLATION

- A. Install units according to printed manufacturer's instructions.
- B. Install frames plumb and level in opening. Secure rigidly in place.
- C. Position unit to provide convenient access to concealed work requiring access.

3.04 SCHEDULE

- A. Minimum Sizes: Coordinate with mechanical specifications and with the specific project requirements.
- B. Walls:
 - 1. In unrated walls, 14 inches by 14 inches: Plumbing valves, reset buttons, control manometers, etc.
 - 2. In unrated walls, 24 inches by 24 inches: Plumbing fittings at toilets, mechanical filter banks, access hatches, areas requiring work access for the unit replacement, etc.
- C. Ceilings:
 - 1. In gypsum board ceilings, 14 inches by 14 inches: Above ceiling cut-off valves, duct dampers, fire and/or smoke dampers, meters, registers, etc.
 - 2. In gypsum board ceilings, 24 inches by 36 inches: HVAC filter units, remote duct dampers, remote fire dampers, remote electrical J-boxes, access hatches, etc.

END OF SECTION

SECTION 08 33 10 – ROLLING COUNTER DOOR

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Electric tube motor operated rolling counter door
- B. Related Sections:
 - 1. Section 08 71 00 Finish Hardware. Master keyed cylinder.
 - 2. Section 09 90 00 – Painting and Coating: Field painting items not finished.
 - 3. Division 26 - Electrical wiring and conduit, fuses, disconnect switches, connection of operator to power supply, and installation of control station and wiring
- C. Products Supplied, But Are Not Installed Under This Section:
 - 1. Control Station

1.02 SUBMITTALS

- A. Reference Section 01 33 00 Submittal Procedures: Submit the following items:
 - 1. Product Data.
 - 2. Shop Drawings: Include special conditions not detailed in Product Data. Show interface with adjacent work.
 - 3. Quality Assurance/Control Submittals:
 - a. Provide manufacturer and installer qualifications - see below.
 - b. Provide manufacturer's installation instructions.
 - 4. Closeout Submittals:
 - a. Operation and Maintenance Manual
 - b. Certificate stating that installed materials comply with this specification

1.03 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installer Qualifications: Manufacturer's approval.

1.04 DELIVERY STORAGE AND HANDLING

- A. Reference Section 01 60 00 Product Requirements.
- B. Follow manufacturer's instructions.

1.05 WARRANTY

- A. Standard Warranty: Two years from date of shipment against defects in material and workmanship.
- B. Maintenance: Submit for owner's consideration and acceptance of a maintenance service agreement for installed products

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a Standard of Quality. Other acceptable manufacturers as listed in Paragraph B, below with products having equivalent characteristics may be considered, provided deviations are minor and do not change concept as expressed in Contract Documents as judged by Architect.
 - 1. Basis of Design product selections:
 - a. Manufacturer: Cornell.
 - b. Product: Rolling counter door.
 - c. Series: ESC10.
 - B. Acceptable Manufacturer: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers listed below.
 - 1. The Cookson Company.
 - 2. Clopay Building Products.
 - C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 MATERIALS

- A. Curtain:
 - 1. Stainless Steel: No. 1F, interlocked flat-faced slats, 1-1/2 inches high by 1/2 inch deep, minimum 22-gauge AISI type 304 #4 finish stainless steel with stainless steel angle bottom bar with lift handles and vinyl sensing edge seal.
 - 2. Finish:
 - a. Stainless Steel: type 304 #4 finish
- B. Endlocks:

1. Fabricate interlocking slat sections with high strength molded nylon endlocks riveted to ends of alternate slats
- C. Guides:
1. Fabrication:
 - a. Stainless Steel: 12 gauge formed shapes.
 2. Finish:
 - b. Stainless Steel: type 304 #4 finish
- D. Shaft Assembly:
1. Tube Motor Shaft Assembly:
 - a. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width
- E. Brackets:
1. Fabricate from reinforced steel plate with bearings at rotating support points to support counterbalance shaft assembly and form end closures.
 2. Finish:
 - a. Standard (Stock Color): Zirconium treatment followed by a gray baked-on polyester powder coat; minimum 2.5 mils cured film thickness
- F. Hood:
1. Minimum 24 -gauge stainless steel with reinforced top and bottom edges.
 2. Finish:
 - a. Stainless steel: type 304 #4 finish

2.03 OPERATION

- A. Electric Tube Motor Operator: Rated for a maximum of 10 cycles per day, cULus recognized, rating as recommended by door manufacturer for size and type of door, 110 Volts, 1 Phase. Provide complete with electric tube motor, maintenance free electric brake, emergency manual crank hoist and control station. Motor shall be protected against overload with an auto-reset thermal sensing device. Operator shall be equipped with an emergency manual crank hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual crank hoist. Operator shall be capable of 10-14 RPM. Fully adjustable, mechanical internal worm limit switch mechanism shall synchronize the operator with the door. The electrical contractor shall mount the control station and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions.

B. Control Station:

1. (Tube Motor Only): Flush mounted: Rocker Switch; NEMA 1

C. Control Operation:

1. Constant pressure to close:
 - a. 2-wire, electric sensing edge seal extending full width of counter door bottom bar. Contact before counter door fully closes shall cause counter door to immediately stop downward travel and reverse direction to the fully opened position. Provide a self-coiling cable connection to control circuit.

2.04 ACCESSORIES

A. Locking:

1. Masterkeyable cylinder lock: Operable from coil side of bottom bar. Provide interlock switches to cut out motor operation when locks are engaged.
 - a. Standard Mortise Cylinder. Coordinate with Section 08 71 00 Finish Hardware.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

3.02 INSTALLATION

- A. Install door and operating equipment with necessary hardware, anchors, inserts, hangers and supports.
- B. Follow manufacturer's installation instructions.

3.03 ADJUSTING

- A. Following completion of installation, including related work by others, lubricate, test, and adjust doors for ease of operation, free from warp, twist, or distortion

3.04 CLEANING

- A. Clean surfaces soiled by work as recommended by manufacturer.
- B. Remove surplus materials and debris from the site.

3.05 DEMONSTRATION

- A. Demonstrate proper operation to Owner's Representative.
- B. Instruct Owner's Representative in maintenance procedures.

END OF SECTION

SECTION 08 41 13 – ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes aluminum-framed storefronts including aluminum doors.
- B. Field testing aluminum storefront(s):
 - 1. Field testing mock-up in accordance with AAMA 503 Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing.
 - 2. Field testing aluminum storefront windows as selected by Architect, installed in the building façade, in accordance with AAMA 503 Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
 - 3. The Contractor is responsible for hiring and paying for the testing services as specified in this Section by an AAMA accredited independent laboratory or testing agency or a laboratory or testing agency in full compliance with ISO/IEC 17025 including repairing, retesting and if required forensic testing any specimens that do not comply with the prescribed air leakage and water penetration resistance requirements of this Section.
 - a. Refer to Submittals and Qualification articles for requirements.
- C. Related Sections:
 - 1. Section 07 27 26 – Fluid-Applied Membrane Air Barriers: Tying air barrier system to storefront frames.
 - 2. Section 07 90 00 – Joint Protection: System perimeter sealant and backup materials.
 - 3. Section 08 71 00 – Door Hardware: Hardware for entrance doors.
 - 4. Section 08 80 00 – Glazing: Installing glass within storefront framing and entrance doors.
 - 5. Section 08 42 29 – Sliding Automatic Entrances: Installing automatic entrances in storefront framing.
 - 6. Section 12 24 13-Manual Window Shades.
- D. Mock-up:
 - 1. Related Sections:
 - a. Section 04 20 19 – Veneer Unit Masonry. Field testing aluminum storefront as part of the mock-up using AAMA 503 Voluntary

Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing, current edition at the time of bid.

1.02 REFERENCES

- A. Aluminum Association:
 - 1. AA DAF-45 – Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
 - 1. AAMA 503 – Voluntary Specification for Field Testing of Metal Storefronts, Curtain Wall and Sloped Glazing Systems.
 - 2. AAMA 611 – Voluntary Specification for Anodized Architectural Aluminum.
 - 3. AAMA 1503 – Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - 4. AAMA CW-10 – Care and Handling of Architectural Aluminum from Shop to Site.
 - 5. AAMA SFM-1 – Aluminum Store Front and Entrance Manual.
 - 6. AAMA LAP-3 – AAMA Laboratory Accreditation Program Operations Manual-Laboratories and Test Agencies Performing On-site Testing of Fenestration Products.
- C. American Society of Civil Engineers:
 - 1. ASCE7 – Minimum Design Loads for Buildings and Other Structures.
- D. American Society for Testing and Materials:
 - 1. ASTM A36/A36M – Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 4. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 5. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 6. ASTM E283 – Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.

7. ASTM E330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 8. ASTM E331 – Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 9. ASTM E547 – Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
 10. ASTM E783 – Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors.
 11. ASTM E1105 – Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
- E. International Organization for Standardization:
1. ISO/IEC 17025 General Requirements for the competence of testing and calibration laboratories.
- F. National Fenestration Rating Council Incorporated:
1. NFRC 100 – Procedures for Determining Fenestration Product U-Factors.
 2. NFRC 200 – Procedures for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence.
- G. SSPC: The Society for Protective Coatings:
1. SSPC Paint 20 – Zinc-Rich Primers (Type I – Inorganic and Type II – Organic).
 2. SSPC Paint 25 – Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.

1.03 SYSTEM DESCRIPTION

- A. Aluminum-framed storefront and entrance systems include tubular aluminum sections, aluminum entrances, shop fabrication, factory finishing, related flashings, anchorage and attachment devices.
1. Where required, due to wind load and spacing requirements of framing, provide tubular sections with supplementary internal steel framing.
- B. System Assembly: Site assembled.

1.04 PERFORMANCE REQUIREMENTS

- A. System Assembly: Accommodate without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction,

dynamic loading and release of loads, deflection of structural support framing.

- B. Wind Loads: Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners:
 - 1. Wind load for exterior assemblies, based on International Building Code, 2015 Edition.
 - a. Refer to Structural drawings for notes regarding the components and cladding design loads.
- C. Deflection: Limit mullion deflection to L/175 for spans up to 13'-6" and L/240 plus 1/4 inch for spans over 13'-6" of span; with full recovery of glazing materials.
- D. Air Infiltration: Test specimen shall be tested in accordance with ASTM E283. Air infiltration rate shall not exceed 0.06 cfm per sq ft. at a static air pressure differential of 6.24 psf.
- E. Water Leakage: None, when measured in accordance with ASTM E331. There shall be no leakage at a minimum static pressure differential of 8 psf as defined by AAMA 501.
- F. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F (95 degrees C) over 12-hour period without causing detrimental effect to system components and anchorage.
- G. System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior by weep drainage network.
- H. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with pane of glass and heel bead of glazing compound.
- I. Entrance Doors:
 - 1. Air Infiltration: For single acting butt hinge entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E283 at a pressure differential of 6.24 psf. for single doors. A single 3'-0" by 7'-0" entrance door and frame shall not exceed .50 cfm per lineal foot of perimeter crack.
 - 2. Structural: Corner strength shall be tested by dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity.

1.05 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.

- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.
- C. Product Data: Submit component dimensions, describe components within assembly, anchorage and fasteners, door hardware and internal drainage details.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Samples: Submit two samples, 12 inches by 12 inches, illustrating finished aluminum.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type of aluminum-framed storefronts.
- G. Design Data: Indicate framing member structural and physical characteristics, calculations, dimensional limitations.
- H. An NFRC Component Modeling Approach (CMA) generated label certificates shall be provided by the manufacturer. The label certificate shall be project specific and will contain the thermal performance ratings of the manufacturer's framing combined with the specified glass, and the glass spacer used in the fenestration of the glass, at NFRC standard test as defined in Table 4-3 in NFRC 100.
- I. Independent Field Testing Laboratory: Provide the name and contact information of the AAMA LAP-3 Accredited Independent Laboratory or testing agency responsible for performing the initial field testing, retesting and if necessary forensic testing of the storefront system.
 - 1. In lieu of being AAMA accredited, the independent field testing laboratory or field testing agency shall be ISO/IEC 17025 accredited. The laboratory/testing agencies accreditation shall only be granted by an accreditation body, or AB, that has an MRA (Mutual Recognition Arrangement) with ILAC (International Laboratory Accreditation Cooperation).
 - a. Those accreditation bodies that are a signatory to ILAC MRA include the following:
 - 1) A2LA: The American Association for Laboratory Accreditation.
 - 2) IAS: The International Accreditation Service.
 - 2. The Contractor shall retain the services of an independent testing laboratory and pay for the costs associated with the initial field testing. Costs associated with retesting and if necessary forensic testing in the event the specimens do not conform to the prescribed air leakage and water resistance requirements shall be paid for by the Contractor.
 - 3. Include a copy of the signed agreement between the Contractor and Testing Laboratory which includes the following costs:

- a. Costs associated with the initial field testing of the mock-up as well as the costs associated with the initial field testing of specimens identified in the Field Quality Control Article of this Section.
 - b. Provide a unit cost per square foot for field testing for air leakage and water leakage. This cost will be used to adjust up or down the budget cost outlined in the Field Quality Control Article of this Section.
4. Laboratories/testing agencies that are ISO/IEC 17025 accredited shall submit a copy of their current certificate of accreditation, along with the name of the accreditation body. The certificate shall remain current through the projects one-year warranty period as listed in Section 10 20 00.
- a. The testing agency shall provide proof that the testing agency is capable of performing, as a minimum, the methods and requirements for field testing storefront products as outlined in ASTM E783 for air leakage, ASTM E1105 for water penetration and AAMA 503.
 - b. The field testing agency shall meet the criteria identified in AAMA LAP-3 Section 7.0 which includes Sections 7.1 through 7.7.

1.06 QUALIFICATIONS

- A. Manufacturer and Installer: Company specializing in manufacturing aluminum glazing systems with minimum three years of documented experience.
- B. Independent Field Testing Agency: The field testing agency shall be AAMA accredited in accordance with LAP-3.
 1. In lieu of the field testing agency being accredited in accordance with AAMA LAP-3, the field testing agency may be ISO/IEC17025 accredited.

1.07 QUALITY ASSURANCE

- A. Perform work in accordance with AAMA-SFM-1.

1.08 DELIVERY, STORAGE AND PROTECTION

- A. Section 01 60 00 – Product Requirements: Product Storage and Handling Requirements.
- B. Protect finished aluminum surfaces with wrapping or strippable coating. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements.
- B. Do not install sealants or glazing materials when ambient temperature is less than 40 degrees F (5 degrees C) during and 48 hours after installation.

1.10 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.

1.12 WARRANTY

- A. Manufacturer's product warranty: Submit for Owner's acceptance, manufacturer's warranty for storefront system as follows:
 - 1. Warranty period: 2 years from date of substantial completion of the project.

PART 2 PRODUCTS

2.01 ALUMINUM-FRAMED STOREFRONTS AND ENTRANCE DOORS

- A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a Standard of Quality.
 - 1. Kawneer Co., Inc
 - a. Storefront Trifab VG 451T (Thermal) Framing System for exterior installations.
 - b. Framing Profile: 2 inches by 4 1/2 inches
 - 1) Center
 - c. Entrance Doors: 500 Heavywall. Refer to door schedule for locations of aluminum doors identified as AL in the door material heading in the schedule.
- B. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit as substitution according to General Conditions of the Contract and appropriate Division 1 sections.
 - 1. EFCO:
 - a. Series 403 (T) for exterior installation with high-performance sill.
 - b. Door: D518 Durastile.
 - 2. TubeLite Inc.
 - a. Series T14000 for exterior installation with high-performance sill.
 - b. Door: Monumental Series.
- C. Product Description:
 - 1. Aluminum Frame: Thermally Broken 2 inch by 4 1/2 inch profile.
 - 2. Doors: Aluminum framed glass doors; 2 inches thick, nominal 5 inch wide top rail and vertical stiles, nominal 10 inch wide bottom rail; square glazing stops. All walls of the door members shall be a minimum .188 inch nominal thickness with .050 inch thick glass stops.

- a. Door Frames: Heavywall, 2 inch by 4 1/2 inch profile.
- D. Door Hardware:
 - 1. Refer to Section 08 71 00 for hardware.
- E. Door Weatherstripping:
 - 1. The door weathering on a single or pair of doors shall be comprised of a thermoplastic elastomer weathering on a tubular shape with a semi-rigid polymeric backing.

2.02 COMPONENTS

- A. Extruded Aluminum: ASTM B221; 6063 Alloy, T6 Temper Typical, 6061 Alloy, T6 Temper for Extruded Structural Members.
- B. Sheet Aluminum: ASTM B209, 5005 Alloy, H15 on H34 Temper
- C. Steel Sections: ASTM A36, shaped to suit mullion sections, galvanized.
- D. Glazing Materials: As specified in Section 08 80 00.
- E. Hardware: As specified in Section 08 71 00.
- F. Sealant and Backing Materials:
 - 1. Sealant Used within System (Not Used for Glazing): Manufacturer's standard materials to achieve weather, moisture, and air infiltration requirements.
 - a. Sealants used within the system shall not come in contact with air barrier membrane, including sealants and tapes. Refer to Section 07 27 26-Fluid-Applied Membrane Air Barrier.
 - 2. Perimeter Sealant: Specified in Section 07 90 00.
- G. Fasteners: Stainless or hot-dip galvanized steel.
 - 1. Use stainless steel where fasteners are exposed and where fastening into preservative-treated lumber and or plywood Type 304 or 316.
- H. Gaskets: Glazing gaskets shall be extruded EPDM rubber.
- I. Thermal Barrier for Trifab VG 451T: Manufacturer's standard thermal break.
- J. Sill Flashing: Provide manufacturer's thermally broken high-performance flashing for use at all storefront sills.
- K. Flat Fillers: Provide each head and jamb member with manufacturer's standard continuous flat filler.
 - 1. At thermally broken systems provide manufacturer's aluminum thermal flat filler. The use of PVC fillers is not acceptable.

2. Provide a cap plate on top of each exterior vertical mullion.
3. Provide a cap plate on top of each vertical stile on each exterior aluminum door.

2.03 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Arrange fasteners and attachments to conceal from view.
- E. Prepare components with internal reinforcement for door hardware.
- F. Reinforce framing members for imposed loads.

2.04 SHOP FINISHING

- A. Clear Anodized Aluminum Surfaces: AAMA 611, AA-M10C21A41/AA-M45C22A41 Architectural Class I, clear anodized 0.7 mils anodized coating.
- B. Concealed Steel Items: Galvanized to ASTM A123, 1.2 oz./sq.ft. coating thickness, galvanize after fabrication.
- C. Apply bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar metals.
- D. Touch-Up Primer for Galvanized Steel Surfaces: SSPC Paint 20 zinc rich.
- E. Extent of Finish:
 1. Apply factory coating to surfaces exposed at completed assemblies.
 2. Apply finish to surfaces cut during fabrication so no natural aluminum is visible in completed assemblies, including joint edges.
 3. Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and Project Conditions.
- B. Verify dimensions, tolerances and method of attachment with other Work.
- C. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work

of this Section.

3.02 INSTALLATION

- A. Install wall system in accordance with AAMA SFM-1 Aluminum Store Front and Entrance Manual.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent Work.
- E. Install Sill Flashings: Turn up ends and edges; seal to adjacent work to form watertight dam.
- F. Install integral flashings and integral sealers.
- G. Set thresholds in bed of mastic and secure.
- H. Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.
- I. Coordinate installation of glass with Section 08 80 00; separate glass from metal surfaces.
- J. Coordinate installation of perimeter sealants with Section 07 90 00.
- K. Bottoms of exterior aluminum doors shall be undercut $\frac{1}{4}$ inch above the threshold.

3.03 ERECTION TOLERANCES

- A. Section 01 40 00 – Quality Requirements: Tolerances.
- B. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 1/16 inches per 10 ft, whichever is less.
- C. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 QUALITY CONTROL-MOCK-UP TESTING

- A. Field test storefront mock-up in accordance with AAMA 503 current edition at the time of bid. Testing shall be performed by an accredited independent testing agency, in compliance with the requirements of this section, employed and paid for by the Contractor. The specimen shall be tested for air leakage and water penetration per the Field Quality Control Article of this Section.
 - 1. Notification of Testing: The Contractor shall provide a minimum of one-week notice to the storefront installer, storefront manufacturer, glazier, caulking contractor, Architect and Owner as to when the fenestration products are ready for testing, including any retesting and forensic testing if required. The

Contractor, storefront installer, storefront manufacturer, glazier, caulking contractor, Architect and Owner shall be present for the test(s).

2. If the specimen does not conform to the prescribed air leakage and water penetration resistance requirements, the storefront manufacturer and installer shall perform a site inspection and determine the reason(s) for non-compliance. The non-compliant specimen shall be repaired and retested at no additional cost to the Owner. Wherever air/water leakage has occurred, the framing shall be made air/water tight in a manner acceptable to the architect and/or owner's representative. Remedial work involving the use of curing-type compounds shall be allowed to set before it is re-checked for leakage.
3. Provide test report in accordance with AAMA 503.

3.05 FIELD QUALITY CONTROL

- A. The newly installed storefront shall be field tested by an accredited independent testing agency, in compliance with the requirements of this section, employed and paid for by Contractor, in accordance with AAMA 503 current edition at the time of bid.
 1. Testing shall be performed soon after the "test area," hereafter referred to as "specimen," is installed, adjusted and cleaned, sealants are cured and prior to the installation of gypsum wallboard, insulation and finish materials.
 2. If interior wall materials have been installed, they shall be removed from the perimeter of the specimen to allow for visual inspection to check for water leakage. The cost (labor and materials, including any overtime) to remove and re-install the gypsum wallboard, insulation or other finish materials shall be the responsibility of the General Contractor.
- B. Specimen:
 1. The test specimen's size and location shall be selected by the Architect. For budget purposes the Contractor shall include in his proposal the cost to test three (3) openings each opening measuring 100 square feet in area.
 - a. The specimens shall include perimeter seals, typical splices, frame intersections, and a minimum of two vision lites and two spandrel lites, if applicable, containing an intermediate vertical and an intermediate horizontal member. See Figure 1 at the end of this section for typical test assemblies.
 - b. Inspection of specimen: The testing agency shall perform a pre-test inspection which includes the following:
 - 1) Check and record in the test report the plumb, level and square condition of the specimen.
 - 2) Report the pre-test condition of all surfaces to confirm that the specimen is in a condition where a judgment can be made as to whether or not water penetration is a result of testing.
- C. Tests:

1. ASTM Test Methods: Field testing procedures and test apparatus shall meet the most current version available during the bid phase of the project.
 2. Resistance to Air Infiltration Using Static Air Pressure Difference: ASTM E783.
 - a. This test shall only be performed on punched openings.
 - b. The maximum allowable rates of air leakage for field testing shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.
 - c. Where air infiltration and water penetration are conducted in sequence, the test for air leakage shall be performed before the test for water penetration.
 - d. Follow AAMA 503 procedures if residual water from rain or other sources maybe located in test specimen prior to proceeding with air leakage test.
 3. Resistance to Water Penetration Using Static Air Pressure Difference: ASTM E1105, Procedure A, Uniform Static Air Pressure Difference.
 - a. Field water penetration resistance tests shall be conducted at a static test pressure of two-thirds of the amount in the performance requirements but not less than 6.24 psf. No water penetration is permitted
- D. When testing results in leakage, eliminate causes of leaks and retest until no leaks occur. In addition to retesting the system(s) that did not pass, air/water test one additional opening as selected by the Architect. The costs for retesting and if necessary forensic testing shall be paid for by the Contractor. The cost for testing the additional opening as selected by the Architect will be paid by the Owner based on the unit cost submitted in accordance with the Submittals Article of this Section.

3.06 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 – Quality Requirements: Manufacturers' field services.
- B. Storefront and glass product manufacturers to provide field surveillance of installation of their Products.
- C. Monitor and report installation procedures and unacceptable conditions.

3.07 ADJUSTING

- A. Adjust operating hardware for smooth operation.

3.08 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.09 PROTECTION OF INSTALLED CONSTRUCTION

- A. Protect finished Work from damage.

END OF SECTION

FIGURES

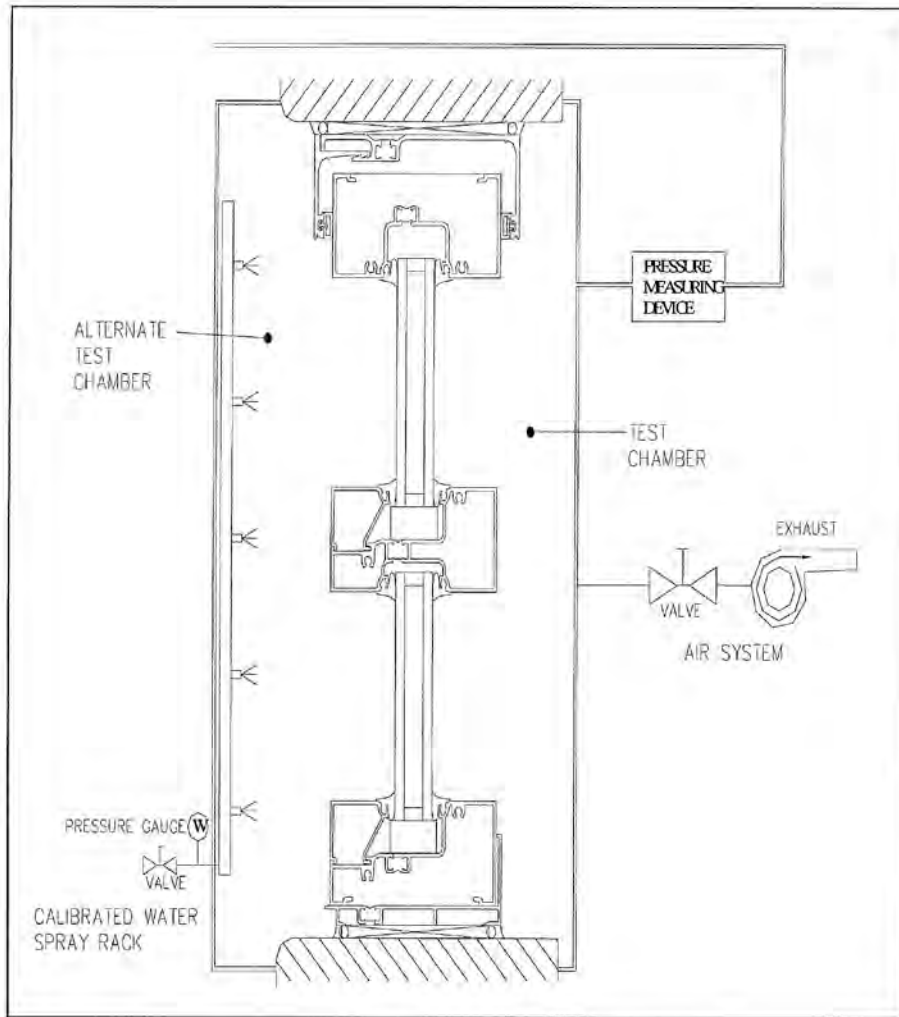


FIGURE 1: STOREFRONT

NOTE 10: The pressure measuring device shall take into account the difference that may exist between the static pressure in the interior of the building and the static pressure on the exterior. It may be possible to open a window or door in a room to balance the pressure. If this is not possible, a measurement of the outdoor wind speed and/or indoor building pressure shall be made and the test pressure adjusted accordingly.

SECTION 08 42 29 - SLIDING AUTOMATIC ENTRANCES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following types of automatic entrances:
 - 1. Exterior and interior, single slide, sliding automatic entrances.
- B. Related Sections:
 - 1. Section 07 90 00 – Joint Protection: Sealants to the extent not specified in this section.
 - 2. Section 08 41 13 - Aluminum-Framed Entrances and Storefronts: For installing sliding automatic entrances in storefront framing.
 - 3. Section 08 71 00 – Finish Hardware: For hardware to the extent not specified in this Section.
 - 4. Section 08 80 00 - Glazing: For materials and installation requirements of glazing for automatic entrances.
 - 5. Division 26 Sections for electrical connections provided separately, including conduit and wiring, for power to sliding automatic entrances.

1.03 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. Underwriters Laboratories (UL):
 - 1. UL 325 – Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- C. American National Standards Institute (ANSI) / Builders' Hardware Manufacturers Association (BHMA):
 - 1. ANSI/BHMA A156.10: Standard for Power Operated Pedestrian Doors.
 - 2. ANSI/BHMA A156.5: Standard for Auxiliary Locks and Associated Products
- D. American Society for Testing and Materials (ASTM):

1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- E. American Association of Automatic Door Manufacturers (AAADM):
- F. National Fire Protection Association (NFPA):
1. NFPA 101 – Life Safety Code.
 2. NFPA 70 – National Electric Code.
- G. International Code Council (ICC):
1. IBC: 2015 International Building Code
- H. International Organization for Standardization (ISO):
1. ISO 9001 - Quality Management Systems
 2. ISO 14025 – Environmental Labels and Declarations -- Type III Environmental Declarations -- Principles and Procedures
 3. ISO14040 – Environmental Management -- Life Cycle Assessment -- Principles and Framework
 4. ISO 14044 – Environmental Management -- Life Cycle Assessment -- Requirements and Guidelines
 5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works -- Core Rules For Environmental Product Declarations Of Construction Products And Services
- I. National Association of Architectural Metal Manufacturers (NAAMM):
1. Metal Finishes Manual for Architectural and Metal Products.
- J. American Architectural Manufacturers Association (AAMA):
1. AAMA 607.1 - Clear Anodic Finishes for Architectural Aluminum.
 2. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.
 3. AAMA 701 Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals.

1.04 DEFINITIONS

- A. Activation Device: Device that, when actuated, sends an electrical signal to the door operator to open the door.

- B. Safety Device: Device that prevents a door from opening or closing, as appropriate.

1.05 PERFORMANCE REQUIREMENTS

- A. General: Provide automatic entrance door assemblies capable of withstanding loads and thermal movements based on testing manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Operating Range: Minus 30 deg F to 130 deg F.
- C. Opening-Force Requirements for Egress Doors: Force shall be adjustable; but, not more than 50 lbf required to manually set swinging egress door panel(s) in motion.
- D. Closing-Force Requirements: Not more than 30 lbf required to prevent door from closing.

1.06 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
- B. Shop Drawings: Include plans, elevations, sections, details, hardware mounting heights, and attachments to other work.
- C. Color Samples for selection of factory-applied color finishes.
- D. Closeout Submittals:
 - 1. Owner's Manual.
 - 2. Warranties.
- E. Reports: Based on evaluation performed by a qualified agency, for automatic entrance door assemblies.
 - 1. Evaluation Report for compliance with IBC.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative, with certificate issued by AAADM, who is trained for installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A qualified manufacturer with a manufacturing facility certified under ISO 9001.
- C. Manufacturer shall have in place a national service dispatch center providing 24 hours a day, 7 days a week, emergency call back service.
- D. Certifications: Automatic sliding door systems shall be certified by the manufacturer to meet performance design criteria in accordance with the following standards:
 - 1. ANSI/BHMA A156.10.

2. NFPA 101.
 3. UL 325 listed.
 4. IBC 2015.
- E. Source Limitations: Obtain automatic entrance door assemblies through one source from a single manufacturer.
- F. Product Options: Drawings indicate sizes, profiles, and dimensional requirements of automatic entrance door assemblies and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- H. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

1.08 PROJECT CONDITIONS

- A. Field Measurements: General Contractor shall verify openings to receive automatic entrance door assemblies by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Mounting Surfaces: General Contractor shall verify all surfaces to be plumb, straight and secure; substrates to be of proper dimension and material.
- C. Other trades: General Contractor shall advise of any inadequate conditions or equipment.

1.09 COORDINATION

- A. Templates: Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing automatic entrances to comply with indicated requirements.
- B. Electrical System Roughing-in: Coordinate layout and installation of automatic entrance door assemblies with connections to power supplies.

1.10 WARRANTY

- A. Automatic Entrances shall be free of defects in material and workmanship for a period of one (1) year from the date of substantial completion.
- B. During the warranty period the Owner shall engage a factory-trained technician to perform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form shall be submitted to the Owner.
- C. During the warranty period all warranty work, including but not limited to emergency service, shall be performed during normal working hours.

PART 2 - PRODUCTS

2.01 MANUFACTURER AND PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a Standard of Quality. Other acceptable manufacturers as listed in Paragraph B, below with products having equivalent characteristics may be considered, provided deviations are minor and do not change concept as expressed in Contract Documents as judged by Architect.
 - 1. Basis of Design product selections:
 - a. Manufacturer: Stanley Access Technologies.
 - b. Product: Dura-Glide 2000 sliding automatic entrances.
 - B. Acceptable Manufacturer: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers listed below.
 - 1. Assa Abloy Entrance Systems.
 - 2. Horton Automatics.
 - C. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

2.02 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - 1. Headers, stiles, rails, and frames: 6063-T6.
 - 2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - 3. Sheet and Plate: ASTM B 209.
- B. Sealants and Joint Fillers: Performed under Division 7 Section "Joint Sealants".

2.03 AUTOMATIC ENTRANCE DOOR ASSEMBLIES

- A. General: Provide manufacturer's standard automatic entrance door assemblies including doors, sidelights, framing, headers, carrier assemblies, roller tracks, door operators, activation and safety devices, and accessories required for a complete installation.
- B. Sliding Automatic Entrances:
 - 1. Single Slide Entrances:
 - a. Configuration: One sliding leaf and one full sidelight.
 - b. Traffic Pattern: Two-way.
 - c. Emergency Breakaway Capability: Sliding leaf only.
 - d. Mounting: Between jambs.

2.04 COMPONENTS

- A. Framing Members: Manufacturer's standard extruded aluminum reinforced as required to support imposed loads.
 - 1. Nominal Size: 1 3/4 inch by 4 1/2 inch.
 - 2. Concealed Fastening: Framing shall incorporate a concealed fastening pocket, and continuous flush insert cover, extending full length of each framing member.
- B. Stile and Rail Doors and Sidelights: Manufacturer's standard 1 3/4 inch thick glazed doors with extruded-aluminum tubular stile and rail members. Incorporate concealed tie-rods that span full length of top and bottom rails.
 - 1. Glazing Stops and Gaskets: Snap-on, extruded-security aluminum stops and preformed gaskets.
 - 2. Stile Design: Medium stile; 3 1/2 inch nominal width.
 - 3. Bottom Rail Design: Minimum 10 inch nominal height.
 - 4. Muntin Bars: None.
- C. Glazing: Furnished under Section 08 80 00 Glazing. All Glazing furnished under separate section shall be 1/4 inch tempered at interior sliding door and 1 inch insulated, hermetically sealed at exterior door.
- D. Headers: Fabricated from extruded aluminum and extending full width of automatic entrance door units to conceal door operators, carrier assemblies, and roller tracks. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
 - 1. Mounting: Concealed, with one side of header flush with framing.
 - 2. Capacity: Capable of supporting up to 220 lb per panel, up to four panels, over spans up to 14 feet without intermediate supports.
- E. Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment of at least 1/8 inch; consisting of urethane with precision steel lubricated ball-bearing wheels, operating on a continuous roller track. Support panels from carrier assembly by load wheels and anti-riser wheels with factory adjusted cantilever and pivot assembly. Minimum two ball-bearing load wheels and two anti-rise rollers for each active leaf. Minimum load wheel diameter shall be 2 1/2 inch; minimum anti-rise roller diameter shall be 2 inch.
- F. Thresholds: Manufacturer's standard thresholds as indicated below:
 - 1. Continuous standard tapered extrusion double bevel.
 - 2. All thresholds to conform to details and requirements for code compliance.
- G. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
- H. Signage: Provide signage in accordance with ANSI/BHMA A156.10.

2.05 DOOR OPERATORS

- A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, operation under normal traffic load for type of occupancy indicated.
- B. Electromechanical Operators: Self-contained overhead unit powered by a minimum of 1/4 horsepower, permanent-magnet DC motor with gear reduction drive, microprocessor controller; and encoder.
 - 1. Operation: Power opening and power closing.
 - 2. Features:
 - a. Adjustable opening and closing speeds.
 - b. Adjustable open check and close check speeds.
 - c. Adjustable hold-open time between 0 and 30 seconds.
 - d. Obstruction recycle.
 - e. On/Off switch to control electric power to operator.
 - f. Energy conservation switch that reduces door-opening width.
 - g. Closed loop speed control with active braking and acceleration.
 - h. Adjustable obstruction recycle time delay.
 - i. Self-adjusting stop position.
 - j. Self-adjusting closing compression force.
 - k. Onboard sensor power supply.
 - l. Onboard sensor monitoring.
 - m. Optional Switch to open/Switch to close operation.
 - n. Fire alarm interface, configurable to safely open or close the entrance on signal from fire alarm system.
 - 3. Mounting: Concealed.
 - 4. Drive System: Synchronous belt type.
- C. Electrical service to door operators shall be provided under Division 26 Electrical. Minimum service to be 120 VAC, 5 amps.

2.06 ELECTRICAL CONTROLS

- A. Electrical Control System: Electrical control system shall include a microprocessor controller and a high-resolution position encoder. The encoder shall monitor revolutions of the operator shaft and send signals to microprocessor controller to define door position and speed.
 - 1. The high-resolution encoder shall have a resolution of not less than 1024 counts per revolution. Systems utilizing external magnets and magnetic switches are not acceptable.
 - 2. Electrical control system shall include a 24 VDC auxiliary output rated at 1 amp.
- B. Performance Data: The microprocessor shall collect, and store performance data as follows:

1. Counter: A non-resettable counter to track operating cycles.
 2. Event Reporting: Unit shall include non-volatile event and error recording including number of occurrences of events and errors, and cycle count of most recent events and errors.
 3. LED Display: Display presenting the current operating state of the controller.
- C. Controller Protection: The microprocessor controller shall incorporate the following features to ensure trouble free operation:
1. Automatic Reset Upon Power Up.
 2. Main Fuse Protection.
 3. Electronic Surge Protection.
 4. Internal Power Supply Protection.
 5. Resettable sensor supply fuse protection.
 6. Motor Protection, over-current protection.
- D. Soft Start/Stop: A “soft-start” “soft-stop” motor driving circuit shall be provided for smooth normal opening and recycling.
- E. Obstruction Recycle: Provide system to recycle the sliding panels when an obstruction is encountered during the closing cycle. If an obstruction is detected, the system shall search for that object on the next closing cycle by reducing door closing speed prior to the previously encountered obstruction location, and will continue to close in check speed until doors are fully closed, at which time the doors will reset to normal speed. If obstruction is encountered again, the door will come to a full stop. The doors shall remain stopped until obstruction is removed and operate signal is given, resetting the door to normal operation.
- F. Programmable Controller: Microprocessor controller shall be field programmable.
1. The following parameters may be adjusted:
 - a. Operating speeds and forces as required to meet specified ANSI/BHMA standard.
 - b. Adjustable and variable features specified.
 - c. Reduced opening position.
 2. Manual programming shall be available through local interface which has a two-digit display with a selection control including three push buttons.

2.07 ACTIVATION AND SAFETY DEVICES

- A. Combined Activation and Safety Sensors: Combined activation and safety sensors shall, in a single housing, detect motion and presence in accordance with ANSI/BHMA A156.10. Motion shall be detected using K-band microwave technology, presence by active infrared reflection technology.

1. Mounting Height: Up to 11.5 feet above finish floor
 2. Temperature Range: Between -31°F and 131°F in all environmental conditions
 3. Relays: Form C, 50V at 0.3A for both activation and safety. Hold time of less than 0.5 seconds.
 4. Detection Pattern: When detection is made in the activation zone, and the entrance opens, the safety zone shall extend through the threshold on each side; creating an X-pattern. When activation and safety zones are cleared and the entrance closes the sensor will ignore the X-pattern safety zones.
 5. Combined motion and presence sensors shall be equal to or better than X-Zone Sensor by Optex.
- B. Photoelectric Beams: In addition to the threshold sensor include a minimum of two (2) doorway holding beams. Photoelectric beams shall be pulsed infrared type, including sender receiver assemblies for recessed mounting.
- C. Presence Sensor Monitoring: Sliding automatic entrances control system shall include a means to verify the functionality of all active presence sensors in accordance with ANSI/BHMA A156.10. A detected fault shall cause automatic operation to cease until the fault is corrected.

2.08 HARDWARE

- A. General: Provide units in sizes and types recommended by automatic entrance door and hardware manufacturers for entrances and uses indicated.
- B. Emergency Breakaway Feature: Provide release hardware that allows panel to swing out in direction of egress to full 90 degrees from any position in sliding mode. Maximum force to open panel shall be 50 lbf according to ANSI/BHMA A156.10. Interrupt powered operation of panel operator while in breakaway mode.
1. Emergency breakaway feature shall include at least one adjustable detent device mounted in the top of each breakaway panel to control panel breakaway force.
 2. Limit Arms: Limit arms shall be provided to control swing of sliding or non-sliding panels on break-out; swing shall not exceed 90 degrees. Limit arms shall be spring loaded to prevent shock, and include adjustable friction damping.
- C. Deadlocks: Manufacturer's standard deadbolt operated by exterior cylinder and interior thumb turn; with minimum 1 inch long throw bolt; ANSI/BHMA A156.5, Grade 1.
1. Cylinders: As specified in Section 08 71 00 Finish Hardware.
 2. Hook Latch: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
- D. Control Switch: Provide manufacturer's standard header mounted rocker switches and door position switch to allow for full control of the automatic entrance door. Controls to include, but are not limited to:
1. One-way traffic

2. Reduced Opening
 3. Open/Closed/Automatic
- E. Power Switch: Sliding automatic entrances shall be equipped with a two position On/Off rocker switch to control power to the door.
- F. Sliding Weather Stripping: Manufacturer's standard replaceable components complying with AAMA 701; made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
- G. Weather Sweeps: Manufacturer's standard adjustable nylon brush sweep mounted to underside of door bottom.

2.09 FABRICATION

- A. General: Factory fabricates automatic entrance door assembly components to designs, sizes, and thickness indicated and to comply with indicated standards.
1. Form aluminum shapes before finishing.
 2. Use concealed fasteners to greatest extent possible.
 - a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
 - b. Reinforce members as required to receive fastener threads.
- B. Framing: Provide automatic entrances as prefabricated assemblies.
1. Fabricate tubular and channel frame assemblies with manufacturer's standard mechanical or welded joints. Provide sub-frames and reinforcement as required for a complete system to support required loads.
 2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
 3. Form profiles that are sharp, straight, and free of defects or deformations.
 4. Prepare components to receive concealed fasteners and anchor and connection devices.
 5. Fabricate components with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
- C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.
- D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.
- E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated.

- F. Hardware: Factory install hardware to the greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site.

2.10 ALUMINUM FINISHES

- A. General: Comply with NAAMM Metal Finishes Manual for Architectural and Metal Products for recommendations for applying and designing finishes. Finish designations prefixed by AA comply with system established by Aluminum Association for designing finishes.
- B. Class II, Clear Anodic Finish: AA-M12C22A31 Mechanical Finish: as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.40 mils minimum complying with AAMA 611-98, and the following:
 - 1. AAMA 607.1
 - 2. Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.]

PART 3 - EXECUTION

3.01 INSPECTION

- A. Examine conditions for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. General: Do not install damaged components. Fit frame joints to produce joints free of burrs and distortion. Rigidly secure non-movement joints.
- B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
 - 1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
 - 2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.
- C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.
- D. Glazing: Performed under Section 08 80 00 Glazing in accordance with sliding automatic entrance manufacturer's instructions.
- E. Sealants: Comply with requirements specified in Section 07 90 00 Joint Protection.

3.03 FIELD QUALITY CONTROL

- A. Testing Services: Factory Trained Installer shall test and inspect each automatic entrance

door to determine compliance of installed systems with applicable ANSI standards.

3.04 ADJUSTING

- A. Adjust door operators, controls, and hardware for smooth and safe operation, for tight closure, and complying with requirements in ANSI/BHMA A156.10.

3.05 CLEANING AND PROTECTION

- A. Clean glass and aluminum surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish. Comply with requirements in Division 8 Section "Glazing", for cleaning and maintaining glass.

END OF SECTION

SECTION 08 71 00 – FINISH HARDWARE

PART 1 – GENERAL:

1.01 SUMMARY:

- A. Section includes the supply and installation of the Finish Hardware.
 - 1. Include the termination of all Electrified Hardware.
 - 2. Include field verification of any existing doors, frames or hardware.

- B. Related Sections
 - 1. Division 1
 - 2. Sealants – Division 7 / Division 7
 - 3. Openings – Division 8 / Division 8
 - 4. Finishes – Division 9 / Division 9
 - 5. Fire Alarm – Division 13/ Division 28
 - 6. Electrical – Division 16 / Division 26
 - 7. Security – Division 16 / Division 28

1.02 REFERENCES:

- A. Documents and Institutes that shall be used in estimating, detailing and installing the items specified.
 - 1. International Building Code – Current/Adopted Edition
 - 2. ICC/ANSI A117.1 – Accessible and Usable Building and Facilities - Current/Adopted Edition
 - 3. NFPA 70 – Current/Adopted Edition
 - 4. NFPA80 –Standards For Fire Doors and Fire Windows – Current/Adopted Edition
 - 5. NFPA101 – Life Safety Code – Current/Adopted Edition
 - 6. NFPA105 – Installation of Smoke-Control Door Assemblies – Current/Adopted Edition.
 - 7. ANSI - American National Standards Institute
 - 8. BHMA – Builders Hardware Manufacturers Association
 - 9. UL – Underwriters Laboratory
 - 10. DHI – Door and Hardware Instatitute
 - 11. Texas Accessibility Standards – Current Adopted Edition
 - 12. Local Building Codes

1.03 SUBMITTALS

- A. Comply with pertinent provisions of Division 01.

- B. Finish Hardware Schedule to be in vertical format to include:
 - 1. Heading #/Hardware Set
 - 2. Door #, Location, Hand, Degree of Opening, Door Size and Type, Frame Size and Type, Fire Rating
 - 3. Quantity, type, style, function, product, product number, size, fasteners, finish and manufacturer of each hardware item.
 - 4. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - 5. Keying schedule
 - 6. Title Sheet, Index, Abbreviations, Manufacturers List, Template List and Templates.
 - 7. Mounting locations for hardware.

8. Explanation of abbreviations, symbols, and codes contained in schedule.
 9. Date of the Finish Hardware Specification and Drawing / Door Schedule used in completing the Finish Hardware Schedule.
 10. In Name, Company and Date of Field Verification if required.
 11. Door Index; include door number, heading number, and hardware group.
 12. Name and phone number for local manufacturer's representative for each product.
 13. Submit in conjunction with Door and Frame Submittal.
 14. Operation Description of openings with electrified hardware.
- C. Product Data: Provide product data in the form of a binder, manufacturer's technical product fact sheets for each item of hardware. Include whatever information may be necessary to show compliance with requirements, including instructions for installation and for maintenance of operating parts and finish.
- D. Wiring Diagrams: Provide Riser/Elevation and Point to Point Wiring Diagrams for all openings with electrified hardware. Include all information that is necessary for coordination with other trades.
- E. Samples: Provide samples as requested by Owner or Architect with Heading # and Door# marked on boxes. All samples will be returned to the contractor and used on doors for which they were marked.
- F. Templates: Provide templates of finish hardware items to each fabricator of doors, frames and other work to be factory or shop prepared for the installation of hardware.
- G. Keying Schedule: After meeting with the Owner, a keying schedule shall be submitted using keyset symbols referenced in DHI manual "Keying Systems and Nomenclature." The keying schedule shall be indexed by door number, keyset, hardware heading number, cross keying instructions and special key stamping instructions.
- H. Operations and maintenance data: At the completion of the job, provide to the Owner one hard copies or one electronic copy of an Owner's operation and maintenance manual. The manual shall consist of a labeled hardcover three ring binder with the following technical information:
1. Title page containing: Project name, address and phone numbers. Supplier's name, address and phone numbers.
 2. Table of Contents.
 3. Copy of final (file and field use/as-installed) Finish Hardware Schedule.
 4. Final Keying Schedule.
 5. Maintenance instruction, adjustment, and preservation of finishes for each item of hardware.
 6. Catalog pages for each items of hardware.
 7. Installation Instructions for each item of hardware
 8. Parts List for each item of hardware.
 9. As installed point to point wiring diagrams for electrified hardware.
 10. Warranties include Order #.
- 1.04 QUALITY ASSURANCES
- A. Substitutions: Request for substitutions shall not be accepted within this project. Architect, Owner and Finish Hardware Consultant have selected one (1) specified and two (2) equals listed hereinafter in the Hardware Schedule. By this selection process they have established three (3) equal products for competitive pricing, while insuring no

unnecessary delays by a substitution process. If any specified product is listed as a "No Substitution" product, this product will be supplied as specified, with no alteration or request of substitution. The reason for this is to comply with the uniformity established at this project. Parts and supplies are inventoried for these particular products for ease and standardization of replacement.

- B. **Supplier Qualifications:** Supplier shall be recognized architectural finish hardware supplier, with warehousing facilities, who have been furnishing hardware in the project vicinity for a period of not less than 2 year and who is or employs a DHI Certified AHC, DHC, DHSC or person with a minimum of 10 years of experience as a hardware supplier. This person shall be available at reasonable times during the course of the work for consultation about products hardware requirements, to the Owner, Architect and General Contractor.
- C. **Installer Qualifications (Mechanical Hardware):** All finish hardware shall be installed by the Finish Hardware Installer with a minimum of at least two (2) years documented experience. Installer shall attend a pre-installation meeting between the General Contractor, Finish Hardware Supplier/s, hardware manufacturer's representative for locks, closers and exit devices, and all door / frame suppliers. The Finish Hardware Installer shall be responsible for the proper installation and function of all doors and hardware.
- D. **Installer Qualifications (Electrified Hardware):** All electrified finish hardware (power source, electrified locking or control device, switching device, through wire device and monitoring device) shall be installed by an Electronic Access Control Installer licensed by the Texas Department of Public Safety. The Electrified Finish Hardware Installer shall have a minimum of at least two (2) years of documented experience. Installer shall attend a pre-installation meeting between the General Contractor, Finish Hardware Supplier/s, Electrical Contractor, Fire Alarm Contractor, Security Contractor, hardware manufacturer's representative for electrified hardware, all door / frame suppliers. The Electrified Finish Hardware Installer shall be responsible for the proper installation, termination and function of all opening with electrified hardware. Installation shall include termination of all electrified products (including the required wire to the power supply and/or junction box).

1.05 DELIVERY, STORAGE AND HANDLING

- A. **Marking and packaging:** Mark each item or package separately, with identification related to hardware set number, door number and keyset symbol.
- B. **Delivery:**
 - 1. Deliver individually packaged and properly marked finish hardware at the proper time and location to avoid any delays in construction or installation.
 - 2. At time of delivery, inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- C. **Storage:** Store hardware in enclosed, dry and locked area.

1.06 WARRANTY

- A. All finish hardware products shall be covered by a 1 year factory warranty from the date of substantial completion of the project.

- B. Supply warranty verification to the owner for all products that provide factory warranty. Warranty should include Factory Order # and date.

1.07 MAINTENANCE

- A. Maintenance Service
 - 1. None
- B. Extra Materials:
 - 1. All extra screws, fasteners, and all special installation tools furnished with the hardware shall be turned over to the owner at the completion of the job.

PART 2 – PRODUCTS

2.01 MATERIALS

- A. Screws and Fasteners:
 - 1. All closers and exit devices provided for exterior doors, hollow metal doors, and all other required shall be provided with thru-bolts.
 - 2. All finish hardware shall be installed to manufacturer's recommendations, using screws, attachments and installation tools provided with the hardware. No other screws or attachments are acceptable.
 - 3. All other products to meet door and frame conditions.
- B. Hinges:
 - 1. Template: Provide templated units only.
 - 2. Exterior: All exterior hinges shall be stainless steel base with stainless steel pin and stainless steel finish.
 - 3. Interior: All interior hinges steel based.
 - 4. Interior corrosive: All interior hinges at corrosive areas shall be stainless steel base with stainless still pin and stainless steel finish.
 - 5. All hinges on doors over 36" wide, with exit devices, or with push/pull shall be heavy weight.
 - 6. Electric Hinge: Provide minimum 8 wire.
 - 7. Provide non-removable pins for outswinging doors that are locked or are lockable.
 - 8. All hinges on doors with door closers shall be ball bearing.
 - 9. All hinges shall be full mortise.
 - 10. Size: Provide 4 ½ x 4 ½ hinges on doors up to 3'0" in width. Provide 5 x 4 ½ hinges over 3'0" to 4'0" in width. Reference manufacturers catalog for all other sizes.
 - 11. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges for door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.
 - 12. Adjust hinge width as required for door, frame, trim and wall conditions to allow proper degree of opening.
 - 13. Provide hinges conforming to ANSI/BHMA A156.1.
 - 14. Provide spring hinges where specified. Provide two spring hinges and one bearing hinge per door leaf for doors 90 inches (2286 mm) or less in height. Provide one additional bearing hinge for each 30 inches (762 mm) of additional door height.
 - 15. Supply from the following list of manufacturers:
 - Ives IVE
 - Hager HAG

Bommer BOM

- C. Grade 1 Cylindrical Locks
1. All locks on this project should be manufacturer by the same manufacturer.
 2. All locks shall meet the new ANSI/BHMA A156.2, Series 4000, Grade 1.
 3. All cylindrical locks shall be UL Listed for 3 hour fire door. Review lock for any height restriction.
 4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with a 1/2 inch (13 mm) latch throw. Provide proper latch throw for UL listing at pairs.
 5. Provide standard ASA strikes unless extended lip strike is necessary for frame/trim or 7/8" lip strike is necessary at pair with overlapping astragal.
 6. Provide dust box.
 7. Lockset shall adjust to fit door thickness from 1 3/4" to 2 1/8".
 8. Supply from the following list of manufacturers:
 9. Schlage SCH
Falcon FAL
Best BES
- D. Grade 2 Cylindrical Locks
1. All locks on this project should be manufacturer by the same manufacturer.
 2. All locks shall meet the new ANSI/BHMA A156.2, Series 4000, Grade 2.
 3. All cylindrical locks shall be UL Listed for 3 hour fire door. Review lock for any height restriction.
 4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with a 1/2 inch (13 mm) latch throw. Provide proper latch throw for UL listing at pairs.
 5. Provide standard ASA strikes unless extended lip strike is necessary for frame/trim or 7/8" lip strike is necessary at pair with overlapping astragal.
 6. Provide dust box.
 7. Lockset shall adjust to fit door thickness from 1 3/4" to 2 1/8".
 8. Supply from the following list of manufacturers:
 9. Schlage SCH
Falcon FAL
Best BES
- E. Exit Devices
1. All exit device types on this project should be manufactured by the same manufacturer.
 2. Exit devices are to be architectural grade touch bar type. Touchpad to extend one half of door width.
 3. Mechanism case to be smooth.
 4. Exit devices shall meet ANSI A156.3, Grade 1.
 5. All exit devices are UL listed Panic Exit or Fire Exit Hardware.
 6. All lever trim to match lock trim in design and finish.
 7. Dogging: Non-rated devices are to be provided with dogging. Less dogging where shown in Hardware Sets (some exterior, electrical rooms, electrified) Cylinder dogging as shown in hardware sets.
 8. Exit devices are to be supplied and installed with thru-bolts for exterior, hollow metal doors, or as required for application.
 9. Provide proper power supply for exit devices as required. Coordinate with Fire Alarm, Electrical and Security Contractor.
 10. Push pads shall be metal, no plastic inserts allowed.

11. Exit devices shall have a flush end cap.
12. Exit devices shall be ordered with the correct strike for application.
13. Exit devices shall be order in the proper length to meet door width.
14. Exit devices shall have deadlatching.
15. Exit device shall be provided in width/height required based on door size.
16. Install exit devices with fasteners supplied by exit device manufacturer.
17. Mount mechanism case flush on face of doors, or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits as required.
18. Provide proper concealed vertical rods for wood or hollow metal doors as required.
19. Factory or field drill weep holes for exit devices used in full exterior applications, highly corrosive areas, and where noted in the hardware sets.
20. Supply from the following list of manufacturers:

Von Duprin	VON	35/98 Series
Falcon	FAL	
Detex	DET	

F. Pull Plates/Pulls/Push Plate

1. Pull and Push Plates to meet ANSI 156.6 for .050" thickness.
2. Pull and Push Plate size to 4" x 16".
3. Pull Plate to have 10" center and 1" round on pull plate with concealed fasteners.
4. Provide straight and offset pulls with fasteners as required
5. Provide concealed fasteners for all applications.
6. Prep plate for cylinder/lock as required.
7. Supply from the following list of manufacturers

Ives	IVE
Trimco	TRI
Rockwood	ROC

G. Door Closers

1. All door closers on this project should be manufactured by the same manufacturer.
2. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
3. Door closers shall be furnished with standard cover. Provide full cover as shown in hardware sets.
4. Size in accordance with the manufacturers recommendations for door size and condition.
5. Door closers shall be furnished with delayed action, hold-open as listed in the Hardware Sets.
6. Door closers shall be mounted out of the line of sight wherever possible (i.e., room side of corridor doors, etc.) with parallel arm mounting on out swinging doors.
7. All closer installation shall include thru bolts on exterior, hollow metal doors or where required for application.
8. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
9. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.

10. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
 11. Supply from the following list of manufacturers

LCN	LCN
Falcon	FAL
Norton	NOR
- H. Door Protection Plates
1. Protective plates shall meet ANSI A156.6 requirements for .050 thickness.
 2. Protection plates should be fabricated from stainless steel.
 3. Protection plate shall be height as shown in Hardware Sets. Width shall be 10" by 2" less than door width on single door or pair with a mullion and 1" less than door width on pair of doors without a mullion.
 4. Beveled 4 edges.
 5. Provide kickplate on all doors with closers, unless not required for aesthetic reasons.
 6. Prep protective plates for hardware as required.
 7. Supply from the following list of manufacturers:

Ives	IVE
Rockwood	ROC
Trimco	TRI
- I. Door Stops and Holders:
1. Supply wall stops at all openings to protect doors or door hardware. Install so lock does not lock unintentionally. Install blocking in wall where wall stop will be mounted.
 2. When wall conditions do not permit use of wall stop provide floor stops with risers as needed to adjust for floor conditions.
 3. When wall conditions do not permit use of wall stop provide overhead stops. Jamb mount where required to not be visible from Corridor.
 4. Exterior Ground Level Doors: Provide security floor stop.
 5. Exterior Roof Doors: Provide heavy duty overhead stop.
 6. Supply from the following list of manufacturers:

Glynn Johnson	GLY
Rockwood	ROC
Trimco	TRI
- J. Silencers
1. Provide silencers on all doors without seal. 3 for single doors and 2 for pairs.
 2. Provide silencers as required for frame conditions. SR64 for hollow metal frames. SR65/SR66 for wood frames.
 3. At wood frames, insure height of stop is compatible with silencer.
 4. Supply from the following list of manufacturer's

Ives	IVE
Rockwood	ROC
Trimco	TRI
- K. Thresholds/Weatherstripping
1. Thresholds on doors in the accessible path shall conform to accessibility codes.
 2. Threshold should be based on sill detail.
 3. Smoke seal shall be teardrop design bulb seal.
 4. Exterior seal/thresholds shall be silicone or brush as shown in hardware sets.

5. Drip strips shall protrude 2 ½" and be 4" wider than opening.
6. At S Label single doors provide seals on frame to comply with UL1784
7. At S Label pair of doors provide seals on frame and as meeting stile to comply with UL1784.
8. Automatic Door Bottom shall be mortised to comply with accessibility codes.
9. Supply from the following list of manufacturer's
Zero ZER
National Guard NGP
Pemko PEM

2.03 KEYING:

- A. General: Finish Hardware Supplier shall meet in person with owner to finalize keying requirements prior to the locks and exit devices being ordered and match existing or start a new Master Key System for the project. During keying meeting all hardware functions should be reviewed with the owner to finalize lock and exit device functions. During keying meeting determine all expansion required.
- B. Cylinders: Provide the correct and quantity of cylinders for all applications.
- C. Keys: Provide nickel silver keys only. Furnish 2 change keys for each lock: 5 control keys: 5 master keys for each master system and 5 grandmaster keys for each grandmaster key system. Deliver all keys to Owners' Representative.
- D. Cores and keys shall be provided with identification stamping.
- E. Provide construction keying / construction cores for this project with constructions keys.
- F. Provide Bitting List to Owner.

2.04 KEY CONTROL:

- A. Key Management: Key control shall be provided, by supplying a complete key storage and management system. Each key shall be fully cut, indexed, tagged and installed on cabinet hooks by the lock supplier and shipped with the locks. Key cabinet provided shall be wall-mounted type with capacity plus 50%.

PART 3 – EXECUTION:

3.01 EXAMINATION:

- A. Examine doors, frames and related items for conditions that would prevent the proper application of any finish hardware items. Do not proceed with installation until all defects are corrected.
- B. Existing Door and Frame Compatibility: Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION:

- A. Follow Door and Hardware Institute Publication:
Recommended Location for Architectural Hardware for Standard Steel Doors and Frames
Recommended Location for Builder's Hardware for Custom Steel Doors and Frames
Recommended Locations for Architectural Hardware for Wood Flush Door
- B. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- C.
- D. Follow ANSI A117.1-1998 Accessible and Usable Building and Facilities and Texas Accessibility Standards.
- E. Review mounting locations with Architect where required.
- F. Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Closers should not be visible in corridors, lobbies and other public spaces where possible.
- G. Locate power supplies in accessible location and indicate in as-builts where located.
- H. Set threshold in full bed of sealant complying with requirements specified in Division 07.
- I. Pre Installation meeting required with attendees to include Architect, General Contractor, Mechanical Hardware Installer, Electrified Hardware Installer, Finish Hardware Supplier and Manufacturer's Representative for Exit Device, Locks and Closers and Door/Frame Suppliers before installation begins.

3.03 FIELD QUALITY CONTROL:

- A. After installation has been completed, obtain the services of an Architectural Hardware Consultant to check for proper installation of finish hardware, according to the finish hardware schedule and keying schedule. In addition, check all hardware for adjustments and proper operation.

3.04 ADJUST AND CLEAN:

- A. Adjust, clean and inspect all hardware, to ensure proper operation and function of every opening. Replace items, which cannot be adjusted to operate freely and smoothly as intended for the application made.

3.05 PROTECTION:

- A. The General Contractor shall use all means at his disposal to protect all finish hardware items from abuse, corrosion and other damage until the owner accepts the project as complete.

3.06 TRAINING

- A. After installation has been completed, provide training to the Owner on the operation of the Finish Hardware and programming of any electrified hardware.

3.07 HARDWARE SCHEDULE

- A. These hardware set shown below are for use as a guideline. Provide hardware as required to meet the requirements of the openings, security, and code requirements.

HARDWARE SET LAYOUT

- 0 – Existing, No Hardware Required or Cylinders
- 1 – Lockset - Office
- 2 – Lockset – Storeroom
- 3 – Latchset - Privacy
- 4 – Latchset - Passage
- 5 – Lockset - Classroom
- 6 – Hospital Latch
- 7 – Panic Hardware
- 8 – Push/Pull
- 9 – Sliding

8/10/21

55927 OPT0216692 Version 3

Hardware Group No. 001

500B

500C

PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CYLINDER	AS REQUIRED	626	FAL
1	EA	SFIC CORE	C607	626	FAL

-Coordinate hardware with door MFR.

Hardware Group No. 002

100B

PROVIDE EACH SL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CYLINDER	AS REQUIRED	626	FAL
1	EA	SFIC CORE	C607	626	FAL

-COORDINATE HARDWARE WITH DOOR MFR.

Hardware Group No. 003

220

401

402

PROVIDE EACH SL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
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-ALL HARDWARE BY DOOR MANUFACTURER.

Hardware Group No. 103

309	310	311	312		
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:					
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRY LOCK	B501H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 103S

103					
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:					
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRY LOCK	B501H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	OH STOP	450S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 201

304A					
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:					
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 201R

305					
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:					
QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S H & J	BK	ZER

Hardware Group No. 203

111A 224 226 228 229 231A
 302 406

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 203G

421

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S H & J	BK	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER

Hardware Group No. 203GS

420A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	OH STOP	450S	630	GLY
1	EA	GASKETING	188S H & J	BK	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER

Hardware Group No. 205

306

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A SS FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

Hardware Group No. 301

313		422		501			
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:							
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR
3	EA	HINGE		5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK		B301S QUA		626	FAL
1	EA	SURFACE CLOSER		SC81A RW/PA FC		689	FAL
1	EA	KICK PLATE		8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP		WS406/407CCV		630	IVE
3	EA	SILENCER		SR64		GRY	IVE

Hardware Group No. 303

222		419					
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:							
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR
3	EA	HINGE		5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK		B301S QUA		626	FAL
1	EA	WALL STOP		WS406/407CCV		630	IVE
3	EA	SILENCER		SR64		GRY	IVE

Hardware Group No. 307

233							
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:							
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR
3	EA	HINGE		5BB1 4.5 X 4.5		630	IVE
1	EA	PRIVACY LOCK		B301S QUA		626	FAL
1	EA	OH STOP		450S		630	GLY
1	EA	SURFACE CLOSER		SC81A RW/PA FC		689	FAL
1	EA	KICK PLATE		8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER		SR64		GRY	IVE

Hardware Group No. 401

230B							
PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:							
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR
3	EA	HINGE		5BB1 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET		B101S QUA		626	FAL
1	EA	SURFACE CLOSER		SC81A RW/PA FC		689	FAL
1	EA	KICK PLATE		8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP		WS406/407CCV		630	IVE
3	EA	SILENCER		SR64		GRY	IVE

Del Valle Health and Wellness Center
 Central Health
 Del Valle, Texas
 Project No. 2070.00

Finish Hardware
 Section 08 71 00.14 of 19

Hardware Group No. 403

232 407

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	B101S QUA	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 403G

408

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	B101S QUA	626	FAL
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S H & J	BK	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER

Hardware Group No. 403GS

208

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	B101S QUA	626	FAL
1	EA	OH STOP	450S	630	GLY
1	EA	GASKETING	188S H & J	BK	ZER
1	EA	DOOR BOTTOM	369AA	AA	ZER

Hardware Group No. 403S

201 202 203 204 205 206
 207 212 213 214 215 216
 217

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	B101S QUA	626	FAL
1	EA	OH STOP	450S	630	GLY
3	EA	SILENCER	SR64	GRY	IVE

Del Valle Health and Wellness Center
 Central Health
 Del Valle, Texas
 Project No. 2070.00

Finish Hardware
 Section 08 71 00.15 of 19

Hardware Group No. 503

219B		221A		221B		300		PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:	
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR		
3	EA	HINGE		5BB1 4.5 X 4.5		652	IVE		
1	EA	CLASSROOM LOCK		B561H7 QUA		626	FAL		
1	EA	SFIC CORE		C607		626	FAL		
1	EA	WALL STOP		WS406/407CCV		630	IVE		
3	EA	SILENCER		SR64		GRY	IVE		

Hardware Group No. 503AS

219A								PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:	
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR		
1	EA	CONT. HINGE		112XY		628	IVE		
1	EA	CLASSROOM LOCK		B561H7 QUA		626	FAL		
1	EA	SFIC CORE		C607		626	FAL		
1	EA	OH STOP		410S		630	GLY		
1	EA	SURFACE CLOSER		SC81A RW/PA FC		689	FAL		

Hardware Group No. 503G

104		423						PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:	
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR		
3	EA	HINGE		5BB1 4.5 X 4.5		652	IVE		
1	EA	CLASSROOM LOCK		B561H7 QUA		626	FAL		
1	EA	SFIC CORE		C607		626	FAL		
1	EA	WALL STOP		WS406/407CCV		630	IVE		
1	EA	GASKETING		188S H & J		BK	ZER		
1	EA	DOOR BOTTOM		369AA		AA	ZER		

Hardware Group No. 801

106		107						PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:	
QTY		DESCRIPTION		CATALOG NUMBER		FINISH	MFR		
3	EA	HINGE		5BB1HW 4.5 X 4.5		652	IVE		
1	EA	PUSH PLATE		8200 4" X 16"		630	IVE		
1	EA	PULL PLATE		8303 10" 4" X 16"		630	IVE		
1	EA	SURFACE CLOSER		SC81A RW/PA FC		689	FAL		
1	EA	KICK PLATE		8400 10" X 2" LDW B-CS		630	IVE		
1	EA	WALL STOP		WS406/407CCV		630	IVE		
3	EA	SILENCER		SR64		GRY	IVE		

Hardware Group No. 921

420B

PROVIDE EACH SL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	POCKET DOOR KIT	9850 SERIES X SIZE AS REQ.		HAG
1	EA	DOOR PULL, 1" ROUND	PR 8103EZHD 10" N	630-316	IVE

-CONFIRM ALL HARDWARE WITH THE DOOR MFR. PRIOR TO SUBMITTALS.

-PROVIDE STOP IN TRACK TO KEEP DOOR 4" INTO OPENING WHEN IN FULLY OPEN POSITION.

-ENSURE 32" OF CLEAR WIDTH IS MAINTAINED IN OPENING.

Hardware Group No. C201

301A 301B 303 400

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	EU STOREROOM LOCK	T881H7 QUA 12/24 VDC	626	FAL
1	EA	CYLINDRICAL LOCK MODIFICATION	1520M AE		ASC
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C201N

209A 227 230A 259 424

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	EU STOREROOM LOCK	T881H7 QUA 12/24 VDC	626	FAL
1	EA	CYLINDRICAL LOCK MODIFICATION	1520M AE		ASC
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. C205

218

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	630	IVE
1	EA	EU STOREROOM LOCK	T881H7 QUA 12/24 VDC	626	FAL
1	EA	CYLINDRICAL LOCK MODIFICATION	1520M AE		ASC
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A SS FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

Hardware Group No. C205A

209 301 414 102

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY TWP	628	IVE
1	EA	EU STOREROOM LOCK	T881H7 QUA 12/24 VDC	626	FAL
1	EA	CYLINDRICAL LOCK MODIFICATION	1520M AE		ASC
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A SS FC	689	FAL
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

Hardware Group No. D001

500D

PROVIDE EACH RU DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CYLINDER	AS REQUIRED	626	FAL
1	EA	SFIC CORE	C607	626	FAL

-COORDINATE HARDWARE WITH DOOR MFR.

Hardware Group No. D002

100A

PROVIDE EACH SL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CYLINDER	AS REQUIRED	626	FAL
1	EA	SFIC CORE	C607	626	FAL

-COORDINATE HARDWARE WITH DOOR MFR.

Hardware Group No. D201

600A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A RW/PA FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. D205

111B 149 231B 304B 307

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A SS FC	689	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

Hardware Group No. D205A

600B

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY	628	IVE
1	EA	STOREROOM LOCK	B581H7 QUA	626	FAL
1	EA	SFIC CORE	C607	626	FAL
1	EA	SURFACE CLOSER	SC81A SS FC	689	FAL
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A	A	ZER

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Hardware Group No. D273QU

500A

PROVIDE EACH SGL DOOR(S) WITH THE FOLLOWING:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	DUTCH DOOR BOLT	054	626	IVE
1	EA	HOTEL GUEST LOCK	MA451H QG	626	FAL
1	EA	ROLLER LATCH	RL30	626	IVE
1	EA	SFIC CORE	C607	626	FAL
1	EA	WALL STOP/HOLDER	WS40	626	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

END OF SECTION

SECTION 08 80 00 – GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass and glazing for doors, interior aluminum frames, aluminum storefront and sliding automatic entrances.

1.02 RELATED SECTIONS

- A. Section 08 11 16 - Interior Aluminum Frames: Aluminum sliding doors, frames and office framing.
- B. Section 08 41 13 – Aluminum-Framed Entrances and Storefronts.
- C. Section 08 42 29 – Sliding Automatic Entrances.

1.03 REFERENCES

- A. American Society of Civil Engineers:
 - 1. ASCE 7 – Minimum Design Loads for Buildings and Other Structures.
- B. ASTM International:
 - 1. ASTM C162 – Standard Terminology of Glass and Glass Products.
 - 2. ASTM C864 – Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks and Spaces.
 - 3. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
 - 4. ASTM C1036 – Standard Specification for Flat Glass.
 - 5. ASTM C1048 – Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
 - 6. ASTM C1193 – Standard Guide for Use of Joint Sealants.
 - 7. ASTM E283 – Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - 8. ASTM E330 – Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - 9. ASTM E546 – Standard Test Method for Frost Point of Sealed Insulating Glass Units.
 - 10. ASTM E576 – Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position.

11. ASTM E773 – Standard Test Method for Seal Durability of Sealed Insulating Glass Units.
 12. ASTM E774 – Standard Specification for Sealed Insulating Glass Units.
 13. ASTM E1300 – Standard Practice for Determining the Minimum Thickness and Type of Glass Required to Resist a Specific Load.
- C. Glass Association of North America:
1. GANA (GM) – FGMA Glazing Manual; Glass Association of North America.
 2. GANA (SM) – FGMA Sealant Manual; Glass Association of North America.
- D. Consumer Products Safety Commission, CPSC 16 CFR 1201 – Safety Standard for Architectural Glazing.

1.04 DEFINITIONS

- A. Sealed Insulating Glass Unit Surfaces:
1. Surface 1 – Exterior surface of outer pane.
 2. Surface 2 – Interior surface of outer pane.
 3. Surface 3 – Interior surface of inner pane.
 4. Surface 4 – Exterior surface of inner pane.

1.05 SYSTEM DESCRIPTION

- A. Design Requirements:
1. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass, including increased loads at building corners, in accordance with 2015 IBC code.
 - a. Design wind load:
 - 1) Refer to Structural drawings for components and cladding design loads.
 - b. Size glass to withstand dead loads and positive and negative live loads acting normal to plane of glass to the design pressures listed above in accordance with ASTM E1300.
 2. Limit glass deflection to 3/4 inch or flexure limit of glass with full recovery of glazing materials, whichever is less.

1.06 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.

- B. Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- C. Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Manufacturer's Installation Instructions: Indicate special precautions required.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Provide material safety and data sheets on all products.
- G. Verification Samples:
 - 1. Flat Glass Materials: Two 12-inch by 12-inch samples of each glass type specified.
 - 2. Sealed Insulating Glass Units: Two 12-inch by 12-inch samples representative of unit construction.
- H. Quality Assurance/Control Submittals:
 - 1. Design Data: Glass size calculations, prepared in accordance with specified method.
 - 2. Certificates: Contractor's certification that:
 - a. Products of this section, as provided, meet or exceed specified requirements.
 - b. Fabricator of flat glass and sealed insulating glass meets specified qualifications.
 - c. Installer of products of this section meets specified qualifications.

1.07 QUALITY ASSURANCE

- A. Glazing Standards: Comply with recommendations of GANA Glazing Manual and GANA Sealant Manual, except where more stringent requirements are indicated. Refer to those publications for definitions of glass and glazing terms not otherwise defined in this section or other referenced standards.
- B. Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with testing requirements of CPSC 16 CFR Part 1201 for category II materials.
 - 1. Identification of Safety Glazing: Each pane of safety glazing installed in hazardous locations shall be identified in accordance with the building code.
- C. Single-Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.
- D. Qualifications:

1. Manufacturer, Flat Glass Materials: Minimum five (5) years of documented experience producing glass products specified in this section.
2. Fabricator of Flat and Sealed Insulating Glass: Minimum five (5) years of documented experience.
3. Installer: Minimum five (5) years of documented experience installing products specified in this section, and approved by fabricator.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Do not install glazing when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Shop Drawings.

1.10 COORDINATION

- A. Coordinate the Work with glazing frames, wall openings and perimeter air and vapor seal to adjacent Work.

1.11 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.
- B. Provide ten (10) year warranty to include replacement of sealed glass units exhibiting seal failure, interpane dusting or misting.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Glass Manufacturers: Subject to compliance with requirements, provide products of one of the following manufacturers:
 1. Manufacturers of Flat Glass Materials:
 - a. Vitro Architectural Glass
 2. Manufacturers offering equivalent products include but are not limited to:
 - a. AGC Flat Glass
 - b. Pilkington
 3. Substitutions: Section 01 60 00 – Product Requirements.

2.02 GLASS FABRICATORS

- A. Subject to compliance with requirements, provide products on one of the following fabricators:
 - 1. Fabricators of Flat Glass Materials:
 - a. Cristacurva
 - b. Oldcastle Glass
 - c. Tristar Glass, Inc.
 - d. Trulite

2.03 GLASS PRODUCTS – GENERAL

- A. Primary Glass Standard: Provide primary glass which complies with ASTM C1036 requirements, including those indicated by reference to type, class, quality and if applicable, form, finish, mesh and pattern.
- B. Heat-Treated Glass Standard: Provide heat-treated glass which complies with ASTM C1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish and pattern.
- C. Tempered Glass Standard: Provide tempered glass which complies with ASTM C1048 requirements, including those indicated by reference to kind, condition, type, quality, class, and, if applicable, form, finish, and pattern.
 - 1. Safety Glass: Furnish tempered glass conforming to CPSC 16 CFR 1201, Category II at locations where safety glass is required by the Code. Refer to the contract documents for the applicable code and year.
- D. Sizes: Fabricate glass to sizes required for glazing openings indicated, with edge clearances and tolerances complying with recommendations of glass manufacturer. Provide thicknesses indicated or, if not otherwise indicated, as recommended by glass manufacturer for application indicated.
- E. Provide the same exterior tinted glass from the same manufacturer.

2.04 GLASS COMPONENTS

- A. Safety Glass (Type SG): Conform to CPSC 16 CFR 120, Category II.
 - 1. Clear tempered glass (Type SG-CT): ASTM C1048, Kind FT fully tempered, Condition A, uncoated, Type 1 transparent flat, Class 1 clear, quality q3 glazing select; with horizontal tempering, 1/4 inch thick.
 - a. Manufacturer: Vitro Architectural Glass
 - b. Clear
 - 1) Visible light transmittance: 89%
 - 2) Shading coefficient: 0.94
 - 3) Solar heat gain coefficient: 0.81
 - 4) Summer U: 0.93
 - 5) Winter U: 1.02

2.05 SEALED INSULATING GLASS UNITS

- A. Fabricate units in accordance with ASTM E774, Class CBA, with components and performance characteristics specified.
- B. Insulated Glass Units, Type SIG-A:
 - 1. Outer Pane
 - a. Glass Type: Vitro Architectural Glass Optigray with Solarban 70 low-e coating on #2 surface
 - b. Glass Color: Gray
 - c. Glass Thickness: 1/4 inch
 - d. Heat Treating
 - 1) Fully tempered
 - 2. Air Space: 1/2 inch wide, hermetically sealed, argon-filled
 - 3. Inner Pane
 - a. Glass Type: Vitro Architectural Glass
 - b. Glass Color: Clear
 - c. Glass Thickness: 1/4 inch
 - d. Heat Treating
 - 1) Fully Tempered
 - 4. Performance Characteristics
 - a. Transmittance:
 - 1) Ultraviolet: 4 percent
 - 2) Visible: 47 percent
 - 3) Total Solar Energy: 18 percent
 - b. Exterior Reflectance:
 - 1) Visible light: 8 percent
 - c. U-Value:
 - 1) Winter nighttime: 0.28
 - 2) Summer daytime: 0.26
 - d. Shading Coefficient: 0.28
 - e. Solar Heat Gain Coefficient: 0.24
 - f. Light to solar gain: 1.96
 - 5. Provide unit edge seals meeting requirements of ASTM E773, with aluminum spacers having mitered and corners, and silicone sealant for glass-to-spacer seals.

2.06 MISCELLANEOUS GLAZING MATERIAL

- A. Compatibility: Provide materials with proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.
- C. Setting Blocks: ASTM C864, neoprene, 80 to 90 Shore A durometer hardness; length 4 inches, width of glazing rabbet space less 1/16-inch, height required for glazing method, pane weight and pane area.
- D. Spacer shims: ASTM C864, neoprene, 50 to 60 Shore A durometer hardness; length 3 inches, one half height of glazing stop, thickness required for application, one face self-adhesive.
- E. Glazing Gaskets: ASTM C864, resilient polyvinyl chloride, extruded shape to fit glazing channel retaining slot; black color.
- F. Glazing Clips: Manufacturer's standard type.
- G. Sealants: Specified in Section 07 90 00.
- H. Silicone Polyester Enamel: Type recommended by flat glass materials manufacturer; color selected by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that openings for glazing are correctly sized and within tolerance.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions and ready to receive glazing.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

3.03 GLAZING – GENERAL

- A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass from edge damage during handling and installation as follows:
 - 1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or

bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.

2. Remove damaged glass from Project site and legally dispose of offsite. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:
1. Locate spacers inside, outside and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.
 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.
- I. Set glass lites in each series with uniform pattern, draw, bow and similar characteristics.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

3.04 INSTALLATION

- A. Install sealants in accordance with sealant manufacturer's written instructions and recommendations.
- B. Gasket Glazing (Dry):
1. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.
 2. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
 3. Install gaskets so they protrude past face of glazing stops.

- C. Installation of glazing in interior aluminum frames and sliding glass doors is specified in Section 08 11 16.
- D. Installation of glazing in aluminum-framed entrances and storefronts is specified in Section 08 41 13.
- E. Installation of glazing in sliding automatic entrances is specified in Section 08 42 29.

3.05 CLEANING

- A. Clean work under provisions of Section 01 70 00.
- B. Remove glazing materials from finish surfaces.
- C. Remove labels after work is complete.
- D. Clean glass.

3.06 PROTECTION OF FINISHED WORK

- A. After installation, mark pane with an "X" by using removable plastic tape or paste.

3.07 GLASS SCHEDULE

EXTERIOR GLASS

- EXT- GLA At all aluminum doors provide Glass Type SIG-A/
- EXT- GLB At all exterior storefront frames provide Glass Type SIG-A.
- EXT- GLC At exterior sliding automatic entrances provide Glass Type SIG-A

INTERIOR GLASS

- INT- GLA At all interior aluminum framing provide Glass Type SG-CT.
- INT- GLB At all interior sliding glass doors and frames provide Glass Type SG-CT.
- INT- GLC At interior sliding automatic entrance provide Glass Type SG-CT.

END OF SECTION

SECTION 08 91 19 – FIXED LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fixed louvers and frames.
 - 1. Stationary type, horizontal, wind-driven, rain-resistant style blades.
- B. Bird screening.

1.02 RELATED SECTIONS

- A. Section 07 27 26 – Fluid-Applied Membrane Air Barrier: Tying air barrier membrane to louver.
- B. Section 07 90 00 – Joint Protection: Sealant at louver perimeter.
- C. Section 23 31 00 – HVAC Ducts and Casings: Ductwork attachment to louver.

1.03 REFERENCES

- A. Air Movement and Control Association International Inc.
 - 1. AMCA 500-L (Air Movement Control Association) – Test Method for Louvers, Dampers, and Shutters.
- B. ASTM International:
 - 1. ASTM A666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip Plate and Flat Bar.
 - 2. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 3. ASTM B221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.

1.04 PERFORMANCE REQUIREMENTS

- A. Louver:
 - 1. Louvers shall meet the performance requirements established by the AMCA 500L test procedure.
 - 2. Louvers shall bear the AMCA Certified Ratings Seal for Water Penetration, Air Performance and Wind Driven Rain.
 - 3. Louvers shall have a minimum free area of 40 percent based on the standard 48 in W x 48 in H test specimen.
 - 4. Louvers shall be not less than 99 percent effective against wind-driven rain when

subjected to a rainfall rate of 3 inches per hour and a wind speed of 29 miles per hour.

a. The beginning point of water penetration shall be greater than 1,250 feet per minute free area velocity.

5. Frame:

a. Depth: Minimum 4 inches.

b. Thickness: Minimum .081 inch.

6. Blade:

a. Thickness: Minimum .063 inch.

7. Louvers shall withstand wind loadings of minimum 25 lbs./sq.ft.

1.05 SUBMITTALS

A. Submit under provisions of Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, and frames.

C. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

D. Samples: Submit two 4 inch x 4 inch metal samples, illustrating finish and color.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with AMCA Certification for water penetration, air performance, and wind driven rain, in compliance with AMCA 500-L. Attach AMCA seal to each louver.

1.07 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years of experience.

1.08 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.09 COORDINATION

A. Coordinate work under provisions of Section 01 30 00 – Administrative Requirements.

B. Coordinate the Work with installation of:

1. Masonry Veneer
- C. Coordinate the Work with installation of mechanical ductwork.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- D. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit as a substitution according to Conditions of the Contract and appropriate Division 1 sections.
1. Airo-lite; SCH401 (Storm Class Horizontal)
 2. Greenheck Louvers; EHH401
 3. Ruskin Louvers; EME420DD

2.02 MATERIALS

- A. Aluminum: 6063 alloy, T5/T6 temper; extruded shape.

2.03 SCREENS

- A. Bird Screen: .625" (5/8") to .75" (3/4") by .040 to .050 inch flattened expanded aluminum, in removable frame. Provide at all louvers.
- B. Bird screen shall be mounted in the same frame. Mount screen on the rear of the louver.

2.04 ACCESSORIES

- A. Fasteners and Anchors: Aluminum or stainless steel type.
- B. Primer: Zinc chromate, alkyd type.
- C. Extended Sill Flashings: Of same material as louver frame.
- D. Sealants: Type specified in Section 07 90 00.
- E. Clip Angles: 1-1/2 inches by 1-1/2 inches by 1/8 aluminum angles.

2.05 FABRICATION

- A. Louver Frame: Minimum 4 inches deep, minimum .081 inch thick extruded aluminum.
- B. Louver Blade Design: Material thickness of minimum .063 inch extruded aluminum.
1. Horizontal rain resistant blades.
- C. Louver Frame:

1. Louver head shall incorporate front drain gutter to channel water to the louver side frame or jambs where water is channeled through vertical downspouts and out the integral sill.
- D. Sill Flashings: Roll formed or Extruded to required shape, single length in one piece per location.
- E. Screens: Louver shall be equipped with a framed, removable rear mounted bird screen.
- F. Each factory assembled louver section shall be designed to withstand wind loadings of minimum 25 pounds per square foot.
- G. At louver head and jambs not installed within curtain wall framing provide a continuous 0.125 inch aluminum channel with 1 inch flanges. Cope and seal corners. Channel shall be welded to the louver frame.

2.06 FACTORY FINISHES

- A. Clear Anodized Aluminum Surfaces: AA-C21A41 non-specular as fabricated mechanical finish, medium matte chemical finish, and Architectural Class I 0.7 mils (0.018 mm) clear anodized coating.
 1. Conform to AAMA 611.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify site conditions under provisions of Section 01 30 00 – Administrative Requirements: Coordination and Project conditions.
- B. Verify that prepared openings are ready to receive work and opening dimensions are as indicated on Shop Drawings.

3.02 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
- B. Install louvers level and plumb.
- C. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- D. Secure louvers in opening framing with exposed fasteners and aluminum clip angles.
- E. Install bird screen and frame to interior of louver.
 1. Install bird screens at all intake, combustion air and exhaust louvers.
- F. Install perimeter sealant and backing rod in accordance with Section 07 90 00.

3.03 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00 – Execution and Closeout Requirements: Testing, adjusting and balancing.

3.04 CLEANING

- A. Clean work under provisions of Section 01 70 00 – Execution and Closeout Requirements: Final cleaning.
- B. Strip protective finish coverings.
- C. Clean surfaces and components.

3.05 SCHEDULE

NAME	SIZE	TYPE	AIR VOLUME (CFM)	MINIMUM FREE AREA (SF)	MAX FACE VELOCITY (FPM)	MAXIMUM PRESSURE DROP (IN H2O)
L1	36"x12"	INTAKE	200	1.2	175	0.05

END OF SECTION

SECTION 09 21 16 – GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Paper Faced Gypsum Board.
- B. Glass-Mat Gypsum Board.
- C. Tile Backer Board.
- D. Drywall Suspension System.
- E. Trim Accessories and Reveals.
- F. Acoustical Sealants and Acoustic Spray.
- G. Acoustic Insulation.
- H. Mold and Moisture Resistant Joint Treatment.

1.02 RELATED SECTIONS

- A. Section 05 40 00 – Cold-Formed Metal Framing: Securing gypsum wallboard to metal framing.
- B. Section 06 10 53 – Miscellaneous Carpentry: Wood blocking for support of fixtures, equipment and trim.
- C. Section 06 16 43 – Gypsum Sheathing: Glass-faced sheathing.
- D. Section 07 21 16 – Blanket Insulation: Thermal insulation.
- E. Section 07 84 00 – Firestopping: Sealing penetrations in fire-rated assemblies with firestopping.
- F. Section 07 90 00 – Joint Protection.
- G. Section 08 31 13 – Access Doors and Frames: Metal access panels.
- H. Section 09 22 16 – Non-Structural Metal Framing: Metal stud framing for walls, partitions, furring, soffits and ceilings.
- I. Section 09 30 00-Tile: Securing tile to tile backer board.
- J. Section 09 72 10-Wall Coverings: Providing a level 4 finish at walls scheduled to receive wall coverings.
- K. Section 09 90 00 – Painting and Coating: Painting gypsum wall board.

1.03 ASSEMBLY PERFORMANCE REQUIREMENTS

- A. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those of assemblies whose STC ratings were determined according to ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency.
- B. Fire Resistance: Provide gypsum board assemblies with fire-resistance ratings indicated.

1.04 REFERENCES

- A. ASTM International:
 - 1. ASTM C475 – Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - 2. ASTM C635 – Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - 3. ASTM C636 -Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - 4. ASTM C641-Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates.
 - 5. ASTM C665 – Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - 6. ASTM C754-Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - 7. ASTM C834 – Standard Specification for Latex Sealants.
 - 8. ASTM C840 – Standard Specification for Application and Finishing of Gypsum Board.
 - 9. ASTM C919 – Standard Practice for Use of Sealants in Acoustical Applications.
 - 10. ASTM C954 – Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. to 0.112 in. in Thickness.
 - 11. ASTM C1002 – Standard Specification for Steel Drill Screws for the Application of Gypsum Board or Metal Plaster Bases.
 - 12. ASTM C1047-Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - 13. ASTM C1178 – Standard Specification for Coated Glass Mat Gypsum Backing Panel.
 - 14. ASTM C1396 – Standard Specification for Gypsum Board.
 - 15. ASTM C1658 – Standard Specification for Glass Mat Gypsum Panels.

16. ASTM D3273 – Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environment Chamber.
 17. ASTM D3274 – Standard Test Method for Evaluating Degree of Disfigurement of Paint Films by Microbial (Fungal or Algal) Growth or Soil and Dirt Accumulation.
 18. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 19. ASTM E90 – Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions.
 20. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
 21. ASTM E413-Classification for Rating Sound Insulation.
- B. Gypsum Association (GA):
1. GA-214 – Recommended Specification: Levels of Gypsum Board Finish.
 2. GA-216 – Recommended Specifications for the Application and Finishing of Gypsum Board.
 3. GA-600 – Fire Resistance Design Manual.
- C. Underwriters Laboratories, Inc.
1. UL Fire Resistance Directory, Current Edition.
- D. Intertek Testing Services:
1. WH (Warnock Hersey) – Certification Listings.
- 1.05 PERFORMANCE CHARACTERISTICS
- A. Acoustic Attenuation for Identified Interior Partitions: Refer to Drawings for STC values in accordance with ASTM E90.
- 1.06 SUBMITTALS
- A. Section 01 33 00 – Submittal Procedures.
- B. Manufacturer’s Literature and Data:
1. Cornerbead, edge trim and aluminum reveals.
 2. Ceiling Suspension System.
 3. Finishing materials.

- a. Provide product data for mold and moisture resistant joint compound and test reports performance under ASTM D3273 and D3274.
- 4. Gypsum board, each type.
- C. Test Results:
 - 1. Fire rating text, each fire rating required for each assembly.

1.07 QUALITY ASSURANCE

- A. Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.
- B. Fire-Test-Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide gypsum board assemblies that comply with the following requirements:
 - 1. Fire-Resistance Ratings: As indicated by GA File Numbers in GA-600 "Fire Resistance Design Manual" or design designations in UL "Fire Resistance Directory" or in the listing of another testing and inspecting agency acceptable to authorities having jurisdiction.
 - 2. Gypsum board assemblies indicated are identical to assemblies tested for fire resistance according to ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Perform work in accordance with GA-214, GA-216 and ASTM C840.
- D. For fire-rated assemblies perform work in accordance with the UL Fire-Resistance Directory.

1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the project site with manufacturer's labels intact and legible. Handle materials with care to prevent damage to edges or surfaces.
- B. Store materials indoors under cover, stacked flat to prevent sagging and off the floor, protected from weather, direct sunlight, surface contamination and damage from construction traffic or other causes.
- C. Store adhesives in dry area and protect against freezing.

1.09 PROJECT CONDITIONS

- A. Environmental Conditions, General: Establish and maintain environmental conditions for applying and finishing gypsum board to comply with ASTM C840 requirements or gypsum board manufacturer's recommendations, whichever are more stringent.
- B. Maintain a room temperature of not less than 40 degrees F for mechanical attachment of gypsum board. For finishing of gypsum board, maintain not less than 50 degrees F (10

degrees C) for 48 hours before application and continuously after until dry. Do not exceed 95 degrees F (35 degrees C) when using temporary heat sources.

- C. Ventilation: Ventilate building spaces as required to dry joint treatment materials. Avoid drafts during hot, dry weather to prevent finishing materials from drying too rapidly.

1.10 MOCK-UP

- A. Section 01 40 00 – Quality Requirements: Requirements for mock-up.
- B. Construct mock-up, 12 feet by 10 feet, including aluminum reveals, joint tape and taping, and bedding compound for Level Four finish. Install panels vertically.
- C. Locate where directed by Architect/Engineer.
- D. Incorporate accepted mock-up as part of Work.

1.11 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Convene minimum two weeks prior to commencing work of this section.

PART 2 PRODUCTS

2.01 GYPSUM BOARD PRODUCTS

- A. General: Provide gypsum board of types indicated in maximum lengths available that will minimize end-to-end butt joints in each area indicated to receive gypsum board application.

Note: The use of gypsum wallboard imported, marketed or distributed by a foreign manufacturer will not be allowed.

- 1. Widths: Provide gypsum board in widths of 48 inches and minimum lengths of 120 inches.
- B. Paper Faced Gypsum Wall Board: Fire-resistive Type X, ASTM C1396 and as follows:
 - 1. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide products by one of the manufacturers listed below, in accordance with UL Design Number U465 for one-hour fire-rated wall assemblies, and non-rated assemblies unless otherwise noted.
 - a. Georgia-Pacific Gypsum, LLC: ToughRock Fireguard X.
 - b. National Gypsum Co.: Gold Bond Fire-Shield Gypsum Board.
 - c. United States Gypsum Co.: Sheetrock Brand Firecode X Panels.
 - 2. Edges: Tapered and featured (rounded or beveled) for prefilling.
 - 3. Thickness 5/8 inch, unless otherwise indicated.

4. Use:
 - a. Base layer at single layer application.
 - b. At ceilings.
- C. Glass Mat, Water-Resistant Mold-Resistant Interior Wall Panel: Coated inorganic glass mat-faced, water-resistant, treated core gypsum wall board.
 1. Acceptable Manufacturers and Products: Subject to compliance with requirements of contract documents, provide products by one of the manufacturers listed below, in accordance with UL Design Number U465 for one-hour fire-rated wall assemblies, and non-rated assemblies.
 - a. Georgia-Pacific Gypsum, LLC: DensArmor Plus Fireguard Interior Panel.
 - b. National Gypsum Company: Gold Bond Brand eXP Fire- Shield Interior Extreme Gypsum Panel.
 - c. USG: Sheetrock Brand Glass-Mat Interior Panels Mold Tough Firecode X.
 2. Standards:
 - a. ASTM C1658 – Standard Specification for Glass Mat Gypsum Panels.
 3. Resists the growth of mold when tested, as manufactured, according to ASTM D3273.
 - a. Panel shall have a score of 10.
 4. Exposure Warranty: Minimum 12 months.
 5. Type: Type X.
 6. Size:
 - a. Thickness: 5/8 inch.
 - b. Width: 4'-0".
 - c. Length: 10'-0".
 7. Edges: Tapered.
 8. Use mold- and moisture-resistant joint treatments with this board.
 9. Use:
 - a. Continuous 3 inch high strip at base of walls where paper faced gypsum board is installed.
- D. Tile Backer Board: Water-resistant treated core with glass mat moisture-protectant coating and glass mats, both sides. The face is surfaced with heat-cured copolymer water-resistant coating.
 1. Acceptable Manufacturers and Products: Subject to compliance with requirements of contract documents, provide products by one of the

manufacturers listed.

- a. Georgia-Pacific Gypsum, LLC: DensShield Fireguard Tile Backer.
- b. National Gypsum Company: Gold Bond Brand eXP Fireshield Tile Backer, Type X.
- c. USG: Durock Brand Glass-Mat Tile Backer Board, Type X.

2. Standards:

- a. ASTM C1178 – Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.

3. Resists the growth of mold when tested, as manufactured, according to ASTM D 3273.

- a. Panel shall have a score of 10.

4. Type: Type X.

5. Size:

- a. Thickness: 5/8 inch.
- b. Width: 4'-0".
- c. Length: 8'-0".

6. Use mold and moisture resistant joint treatments with this board. Where tile is installed use mortar used to set tile to treat fasteners and panel joints.

7. Use: Base layer at single layer application.

2.02 DRYWALL SUSPENSION SYSTEM

- A. General: Provide components complying with ASTM C754 for conditions indicated.
- B. Wire Hangers: ASTM A641, Class 1 zinc coating, soft temper, 12 gauge diameter.
- C. Grid Suspension System for Interior Ceilings: ASTM C635, manufacturer's standard hot-dipped galvanized direct-hung grid suspension system composed of main beams and cross-furring members than interlock to form a modular supporting network.

1. USG Drywall Suspension System

- a. Class: Heavy Duty
- b. Main Tee: DGLW-26 – 12-foot length, 1-1/2 inch face
- c. Cross Tee: DGLW424 – 4-foot length, 1-1/2 inch face.
 - 1) DGLW224, 2 foot long accessory cross tee, 1-1/2 inch face
- d. Molding: DGWM-24, 1 inch by 1-1/2 inch by 12 feet long
- e. DGSC-180 splice clip, for joining two in-line main tees field cut to length, or for joining two grid tees intersecting off module.

2. Substitutions: Products from the following manufacturers may be submitted:

- a. Armstrong Drywall Grid System.

2.03 TRIM ACCESSORIES

- A. Accessories for Interior Installation: Cornerbead, edge trim and control joints complying with ASTM C1047 and requirements indicated below:

1. Material: Formed metal or plastic, with metal complying with the following requirement:
 - a. Steel sheet zinc coated by hot-dip process or rolled zinc.
2. Shapes indicated below by referenced to Fig. 1 designations in ASTM C1047:
 - a. Cornerbead on outside corners, unless otherwise indicated.
 - b. L-bead with face flange only; face flange formed to receive joint compound. Use L-bead at window openings, door openings, casements and where indicated.
 - c. One-piece control joint formed with V-shaped slot and removable strip covering slot opening equal to USG 093.

- B. Aluminum Reveals:

1. Basis of Design: Contract documents are based on product from Fry Reglet Architectural Metals to establish a standard of quality. Substitutions are permitted in accordance with Section 01 60 00.
 - a. Material: Extruded aluminum alloy 6063 T5.
2. Products:
 - a. Refer to drawings for model numbers and finish. Snap-in reveals.
 - 1) Provide snap-in reveal where vinyl wallcovering and/or vinyl wall protection is shown on Drawings.
 - b. Corner trim: As required.
 - c. Accessories:
 - 1) Factory-fabricated "T," "L," "+" intersections for horizontal and vertical joints, and/or outside and inside corners. Joints shall be mitered in the factory and heliarc welded with 6-inch-long legs. Finish to match reveals.
 - 2) End caps: As required.

2.04 JOINT TREATMENT MATERIALS

- A. General: Provide joint treatment materials complying with ASTM C475 and the recommendations of both the manufacturers of sheet products and of joint treatment materials for each application indicated.
- B. Joint Tape for Gypsum Board:

1. 2 inch wide 10 by 10 glass fiber mesh tape.(all)
- C. Setting-Type Joint Compounds manufactured to ASTM C475. Factory-packaged, mold and moisture resistant, job-mixed, chemical-hardening powder products formulated for uses indicated.
1. Where setting-type joint compounds are indicated as a taping compound only or for taping and filling only, use formulation that is compatible with other joint compounds applied over it.
 2. Prefilling: At open joints, rounded or beveled panel edges, damaged surfaces, and laminating gypsum boards together.
 3. Gypsum board installed in non-tile, non-wet areas, scheduled for painting:
 - a. Embedding and first coat: For embedding glass fiber tape and first coat on joint fasteners and trim flanges, use setting-type taping compound.
 - b. Fill coat: For second coat use setting-type, sandable topping compound.
 - c. Finish coat: For third coat, use setting-type, sandable topping compound.
- D. Tile backer board:
1. At tile backer board installed in areas scheduled to be tiled, imbed glass fiber tape in mortar used to install tile. Refer to Section 09 30 00 – Tiling.

2.05 ACOUSTICAL SEALANT AND SPRAY

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C834, ASTM C919 and the following requirements.
1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
- B. Products: Subject to compliance with requirements, provide one of the following:
1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. AC-20 FTR (fire and temperature rated) Acoustical and Insulation Sealant; Pecora Corp.; VOC content 31 g/L < 250 g/L.
 - b. Sheetrock Brand Acoustical Sealant; United States Gypsum Co.; VOC content 15 g/L < 250 g/L.
 - c. Tremco Acoustical Sealant, VOC content 150 g/L < 250 g/L.
 2. Acoustic spray for Head of Wall Exposed and Concealed Joints:
 - a. Hilti CP 572 Smoke and Acoustic Spray: VOC content 91 g/L < 250 g/L.
 - 1) Sound transmission classification: STC 56.
 - 2) Flame spread/Smoke developed: 10/5.
 - 3) Spary shall be mold and mildew resistant per ASTM G21 with a rating of zero (0) no growth.

- 4) Spray has a movement capability of 12.5 percent.
- 5) Accessories:
 - a) CP 767 Speed Strips.
 - b) CP 777 Speed Plugs
 - c) Mineral wool.

2.06 ACOUSTIC INSULATION

- A. ASTM C665, Type 1; friction fit type, unfaced, cut to fit stud spacing.
 - 1. Thickness:
 - a. 3 1/2 inches at 3 5/8 inch metal studs.
 - b. 6 inches at 6 inch metal studs.
 - 2. Facing: Unfaced.
 - 3. Flame/smoke properties: 25/450 in accordance with ASTM E84.
 - 4. Material shall be formaldehyde free.
 - 5. Products/Manufacturer:
 - a. Certainteed sustainable insulation CertaPro AcoustaTherm Batts, Certainteed Corporation.
 - b. Unfaced formaldehyde-free batt insulation, Johns Manville.
 - c. EcoTouch Pink Fiberglass Insulation, Owens Corning
 - d. Substitutions per Section 01 60 00.

2.07 MISCELLANEOUS MATERIALS

- A. General: Provide auxiliary materials for gypsum board construction that comply with referenced standards and recommendations of gypsum board manufacturer.
- B. Gypsum Board Screws: Self-drilling, self-tapping steel screws.
 - 1. For steel framing less than 0.03 inch thick, comply with ASTM C1002.
 - 2. For steel framing from 0.033 inch thick to 0.112 inch thick, comply with ASTM C954.
 - 3. Provide Type S or Type S-12 screws, rust resistant, lengths as required to suit application as noted below:
 - a. Where securing one layer of 5/8 inch Type "X" gypsum wallboard to framing: Provide 1 inch long steel screws unless noted otherwise.
 - b. Where securing tile backer board to framing: Provide type of screw and minimum length as recommended by board manufacturer.
- C. Sealant:
 - 1. ASTM C920, Type S, Grade NS, Class 25, Use NT, Use 1, Use M, Use G. Flexible mildew-resistant 100% silicone sealant.

2. Manufacturers/products:
 - a. Laticrete/Latasil VOC content 37.16 g/L < 250 g/L.
 - b. Sealing joints in glass-faced tile backing board.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, and structural framing, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of assemblies specified in this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF STEEL FRAMING FOR SUSPENDED AND FURRED CEILINGS

- A. Install in accordance with ASTM C636.
- B. Suspend ceiling hangers from building structural members and as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
 3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews or other devices and fasteners that are secure and appropriate for substrate and in a manner that will not cause them to deteriorate or otherwise fail.
 4. Do not support ceilings directly from permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 5. Do not attach hangers to steel deck tabs.
 6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 7. Do not connect or suspend steel framing from ducts, pipes or conduit.
- C. Sway-brace suspended steel framing with hangers used for support.
- D. Install suspended steel framing components in sizes and at spacings indicated, but not less than that required by the referenced steel framing installation standard.

1. Grid Suspension System:
 - a. Wire Hangers: Maximum 48 inches o.c. At ceilings where tile backer board is installed, install wire hangers at maximum 36 inch o.c.
 - b. Main Beams: Maximum 48 inches o.c.
 - c. Cross Furring Members (Furring Members): Maximum 16 inches o.c.
- E. Installation Tolerances: Install steel framing components for suspended ceilings so that cross-furring or grid suspension members are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) as measured both lengthwise on each member and transversely between parallel members.
- F. Grid Suspension System: Attach perimeter wall track or angle where grid suspension system meets vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

3.03 APPLYING AND FINISHING GYPSUM BOARD – GENERAL

- A. Gypsum Board Application and Finishing Standards: Install and finish gypsum panels to comply with ASTM C840, GA-214, GA-216 and UL assembly numbers.
- B. Confirm sound-attenuation blankets have been installed where indicated prior to installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels perpendicular to framing members spaced at 16 inches o.c. and across framing to minimize the number of abutting-end joints and to avoid abutting-end joints in the central area of each ceiling. Stagger abutting-end joints of adjacent panels not less than one framing member. Install gypsum and/or tile backer board panels on ceiling before wall/partition board application.
- D. Install gypsum panels with face side out. Do not install imperfect, damaged or damp panels. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate both edge or end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Avoid joints other than control joints at corners of framed openings where possible.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.
- H. Form and install control and expansion joints at locations indicated and as follows with space between edges of adjoining gypsum panels, as well as supporting framing behind gypsum panels:
 1. Ceilings: Install joints in ceilings exceeding 900 square feet in area. The distance between ceiling control joints shall not exceed 30 feet in either direction. Install control joints where ceiling framing or furring changes direction.

2. Partitions, walls and wall furring: Install joints in partitions, walls and wall furring with runs exceeding 30 feet. Distance between control joints shall not exceed 30 feet, and control joints shall be installed where an expansion joint occurs in the base exterior wall.
 3. At all door frames, provide control joints at each corner of the door frame and extend joints from top of frame up to bottom of structure/ deck. At all door frames located in interior partitions, locate control joints on both sides of partitions. At door frames on exterior walls provide control joints on interior side.
 4. At all window frames, provide control joints at each corner, starting at the floor line and extending up to the structure. At all window frames located in interior partitions, locate control joints on both sides of partitions and extend up to bottom of structure/deck. At window frames on exterior walls provide control joints on interior side.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chassis that are braced internally.
1. Except where concealed application is indicated or required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 2. Fit gypsum panels around ducts, pipes and conduits.
 3. Where partitions intersect steel beams, steel joists, and other structural members projecting below underside of roof decks, cut gypsum panels to fit profile formed by beams, joists, and other structural members; allow 1/2 inch wide joints to install sealant. Where partitions intersect the bottom of roof decks, cut gypsum wallboard to the profile of the deck; allow 1/2 inch wide joints to install sealant.
- J. At non-rated, non-load-bearing partitions that extend to the underside of the roof deck, isolate perimeter of the gypsum board partitions at structural abutments and roof deck, as detailed. Provide 1/2 inch wide spaces at these locations. Seal joints between abutting structural surfaces, roof deck etc. with acoustical sealant, unless otherwise noted.
- K. At fire-rated non-load-bearing partitions, terminate the gypsum panels 1/2 inch below the bottom/sides/top of beams, joists, roof deck. Refer to UL head wall assemblies HW-D-0042 and HW-D-0049 for steel decks in the UL Fire Resistance Directory.
- L. Where STC-rated gypsum board assemblies are indicated, seal construction at perimeters, behind control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of the partitions. Comply with ASTM C919 and manufacturer's recommendations for location of edge trim and closing off sound flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
- M. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's recommendations.
1. Space screws a maximum of 12 inches o.c. for vertical applications.
 2. At fire-rated partitions, space fasteners in conformance with specified UL Design

Numbers.

- N. Space fasteners in panels that are tile substrates a maximum of 6 inches o.c.

3.04 GYPSUM BOARD APPLICATION METHODS

- A. Single-Layer Application: Install gypsum wallboard panels as follows:

1. On ceilings, apply gypsum panels prior to wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), and provide panel lengths that will minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of board.

- B. Paper Faced Gypsum Board:

1. Unless otherwise noted install the following system at all interior metal stud partition walls and interior side of exterior walls.
 - a. Install a layer of paper faced gypsum board.
 - b. Install a layer of paper faced gypsum board on ceilings.

- C. Glass-Mat Gypsum Board:

1. Unless otherwise noted install the following system at all interior metal stud partition walls and interior side of exterior walls.
 - a. Continuous 3 inch high strip of glass-mat gypsum board placed at base of walls where paper faced gypsum board is installed.

- D. Tile Backer Board:

1. Install tile backer board panels around the perimeter of all shower walls, and all areas scheduled to be tiled. Install with coated surface away from studs. Locate edge joints parallel to and on framing. Stagger intermediate end joints of adjacent lengths. Secure boards to studs with Type S-12 bugle head, self-tapping, rust resistant, fine thread minimum 1 5/8 inch screws at 6 inches o.c or type of fastener recommended by board manufacturer. At light gauge framing provide Type S, bugle self-tapping rust-resistant 1 1/4 inch screws at 6 inches o.c. or type of fastener recommended by board manufacturer. Butt ends and edges. Install with 1/4 inch open space where panels abut other construction or penetrations. Seal ends, cut edges and penetrations of each piece with water-resistant adhesive or where recommended by board manufacturer with water-resistant joint compound. Panels shall be installed horizontally.
 - a. Where ceilings are installed, extend tile backer board to ceiling leaving a 1/8 inch gap at corner.

- b. Where ceilings are not installed, extend tile backer board up to the underside of the roof deck.

E. Single-Layer Fastening Methods: Apply gypsum panels to supports as follows:

1. Fasten with screws.
2. At rated partitions comply with UL Design numbers for fastening.

3.05 INSTALLING TRIM ACCESSORIES

A. General: For trim accessories with back flanges, fasten to framing with the same fasteners used to fasten gypsum board. Otherwise, fasten trim accessories according to accessory manufacturer's directions for type, length and spacing of fasteners.

B. Install cornerbead at all external corners.

C. Install edge trim where edge of gypsum panels would otherwise be exposed. Provide edge trim type with face flange formed to receive joint compound, except where other types are indicated.

1. Install LC-bead where gypsum panels are tightly abutted to other construction and back flange can be attached to framing or supporting substrate.

D. Install control joints according to ASTM C840 and manufacturer's recommendations and in specific locations approved by Architect for visual effect.

E. Aluminum Trim and Reveals:

1. Tapeable Flange Shapes:
 - a. Install moldings after gypsum board is installed. Verify a steel backing plate has been installed behind the moldings.
 - b. Secure the moldings to the backing plate/stud framing using Type S or S-12 screws at 8 inches o.c.
 - c. Prior to taping, clean attachment flanges.
 - d. Tape flanges using self-adhesive fiberglass tape.
 - e. Field cut trim using a chop saw with a 150-tooth blade for non-ferrous metal. Lubricate blade prior to cutting per manufacturer's instructions.

3.06 ACOUSTICAL SEALANT AND SPRAY

A. Acoustical Sealant and Spray Application Standard: Comply with recommendations of ASTM C919 for use of joint sealants in acoustical applications as applicable to materials, applications and conditions indicated. Install sealant and spray in sound-rated interior partitions.

1. Install acoustical sealant prior to installing gypsum board panels. Gypsum board panels shall be pushed into the sealant.
2. Install acoustic spray backings of type to support spray during application in accordance with manufacturer's written installation instructions.

3.07 ACOUSTIC INSULATION

- A. Install insulation in accordance with insulation manufacturer's instructions.
 - 1. Place acoustic insulation in partitions tight within spaces, around cut openings, behind electrical and mechanical items within or behind partitions, and tight to items passing through partitions.
- B. Install insulation where shown on the Drawings.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.

3.08 FINISHING GYPSUM BOARD ASSEMBLIES

- A. General: Treat gypsum board joints, interior angles, flanges of cornerbead, edge trim, control joints, penetrations, fastener heads, surface defects and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Prefill open joints, rounded or beveled edges and damaged areas using setting-type compound.
- C. Apply joint tape over gypsum board joints, except those with trim accessories having flanges not requiring tape.
- D. Apply joint tape over gypsum board joints and to flanges of trim accessories as recommended by trim accessory manufacturer.
- E. Levels of Gypsum Board Finish: Provide the following levels of gypsum board finish per GA-214.
 - 1. Level 1 for ceiling plenum areas, concealed areas and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 - 2. Level 4 for walls and ceilings exposed to view.
 - a. Level 4 for walls scheduled to receive wall coverings.
- F. Use the following joint compound combinations as applicable to the finish levels specified.
 - 1. Sandable Setting Type: Embedding and First Coat: Sandable setting-type joint compound. Fill (Second) coat: Sandable setting-type joint compound. Finish (Third) Coat: Sandable setting-type joint compound.
- G. Level 1:
 - 1. All joints and interior angles shall have tape set in joint compound. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.
- H. Level 4 finish for all surfaces to be painted and/or schedule to receive wall coverings.

1. All joints and interior angles shall have tape embedded in joint compound and two separate coats of joint compound applied over all flat joints and one separate coat of joint compound applied over interior angles.
2. All fastener heads and accessories shall be covered with three separate coats of joint compound.
3. All joint compounds shall be smooth and free of tool marks and ridges.

I. Glass-Faced Tile Backing Board:

1. Tile substrate (walls) in wet areas. Georgia-Pacific DS001 system, National Gypsum Company tile application, USG tile application and CertainTeed tile application.
 - a. Install fasteners flush with coated surface; do not countersink.
 - b. Leave a minimum 1/8 inch gap in all vertical corners and fill with 100% silicone sealant. Bed self-adhesive 2-inch-wide fiberglass mesh tape into sealant. Follow installation requirements of board manufacturer.
 - c. At all other joints bed self-adhesive 2-inch-wide fiberglass mesh tape into material used to set tiles. Coordinate with Section 09 30 00 – Tiling.
 - d. Fill 1/4 inch joint between shower pan with 100 percent silicone sealant. Do not install tile backer board into shower pan mortar bed.

3.09 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Architect will conduct an above-ceiling observation prior to installation of gypsum board ceilings and report any deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
1. Notify Architect one week in advance of the date and the time when the Project, or part of the Project, will be ready for an above-ceiling observation.
 2. Prior to notifying Architect, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of eighty percent (80%) of lighting fixtures, powered for operation.
 - b. Installation, insulation and leak and pressure testing of water piping systems.
 - c. Installation of air duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control air tubing.
 - f. Installation of ceiling support framing.

3.10 CLEANING AND PROTECTION

- A. Promptly remove any residual joint compound from adjacent surfaces.
- B. Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure gypsum board assemblies are without damage or deterioration at the time of

Substantial Completion.

- C. Remove and replace panels that are wet, moisture damaged and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

3.11 PARTITION IDENTIFICATION

- A. Identify rated partitions and smokestop partitions required to have protected openings with permanent signs or stencils above ceilings and in concealed spaces.
- B. Partitions to be identified:
 - 1. Fire rated walls with protected openings.
- C. Stencil with minimum 3-inch-high red lettering with minimum 3/8 inch stroke "FIRE AND/OR SMOKE BARRIER-PROTECT ALL OPENINGS" every 20'-0".
- D. Identification to be done in a manner acceptable to the authority having jurisdiction.

END OF SECTION

SECTION 09 22 16 – NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.01 WORK INCLUDED

- A. Interior (drywall) non-load-bearing non-structural framing.
- B. Furring.
- C. Accessories.

1.02 RELATED SECTIONS

- A. Section 01 33 00 – Submittal Procedures.
- B. Section 01 60 00 – Product Requirements: Product substitution procedures.
- C. Section 06 10 53 – Miscellaneous Carpentry: Securing wood blocking to steel studs.
- D. Section 07 21 16 – Blanket Insulation: Insulation within framing members of studs.
- E. Section 09 21 16 – Gypsum Board Assemblies: Securing gypsum wall board and aluminum trim and reveals to framing.
- F. Section 10 26 00 – Wall Protection: Installing metal stud blocking behind:
 - 1. Corner Guards.
 - 2. Chair Rails.
- G. Section 10 28 00 – Toilet, Bath and Laundry Accessories: Supporting toilet accessories off steel stud framing.

1.03 REFERENCES

- A. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- B. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot Dip Process.
- C. ASTM A780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- D. ASTM A1003 – Standard Specification for Steel Sheet, Carbon Metallic and Non-Metallic-Coated for Cold-Formed Framing Members.
- E. ASTM C645 – Standard Specification for Non-Structural Steel Framing Members.
- F. ASTM C754 – Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- G. ASTM C1002 – Standard Specification for Steel Drill Screws for Application of Gypsum

Panel Products on Metal Plaster Bases.

- H. ASTM E90 – Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions.
 - I. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
 - J. ASTM E413-Classification for Rating Sound Insulation.
 - K. Certified Steel Stud Association (CSSA)
 - L. SSPC: The Society for Protective Coatings:
 - 1. SSPC Paint 20 – Zinc-Rich Primers (Type I – Inorganic and Type II – Organic).
 - M. Steel Stud Manufacturers Association (SSMA).
 - N. Steel Framing Industry Association (SFIA).
 - O. UL Fire Resistance Directory (Current Edition).
 - P. AISI – (American Iron and Steel Institute).
 - 1. S220 North American Standard for-Cold-Formed Steel Framing-Nonstructural Members. Edition based on building code adopted.
 - Q. FS TT-P-645 – Primer, Paint, Zinc-2 Chromate, Alkyd Type.
- 1.04 PERFORMANCE REQUIREMENTS – INTERIOR (DRYWALL) NON-LOAD-BEARING STEEL STUD FRAMING
- A. Maximum Allowable Deflection: L/240 span, with a minimum load of 5 pounds per square foot applied perpendicular to walls.
 - 1. Where tile is installed, the deflection shall be L/360, with a minimum load of 5 pounds per square foot applied perpendicular to walls.
 - B. Design framing system to accommodate deflection of building. Structure and construction tolerances:
 - 1. Vertical Deflection: 1/2 inch.
- 1.05 SUBMITTALS – INTERIOR (DRYWALL) NON-LOAD-BEARING NON-STRUCTURAL FRAMING
- A. Section 01 33 00 – Submittal Procedures: Submittal Procedures.
 - B. Product Data: Provide data describing standard framing member materials and finish, product criteria, load charts, limitations and type of fasteners.
 - C. Manufacturer's height limiting tables indicating products provided based on:
 - 1. Composite framing.

2. Non-composite fully braced: Gypsum board on both sides of stud stop maximum 12 inches below top track.
 3. Non-composite fully braced: Bracing spacing above gypsum board on both sides of stud is less than Lu.
 4. Non-composite: Bracing spaced at 48 inches on center with gypsum board on one side.
- D. Studs and runners: Provide documentation that framing member's certification is according to:
1. SFIA's Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members based on checking mechanical properties, coatings, dimensions and labeling per:
 - a. IBC 2015: AISI S220 and ASTM C645, Section 10.
 2. SSMA's Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members based on checking mechanical properties, coatings, dimensions and labeling per:
 - a. IBC 2015: AISI S220 and ASTM C645, Section 10.
 3. CSSA's Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members based on checking mechanical properties, coatings, dimensions and labeling per:
 - a. IBC 2015: AISI S220 and ASTM C645, Section 10.
- 1.06 QUALITY ASSURANCE – INTERIOR (DRYWALL) NON-LOAD-BEARING NON-STRUCTURAL FRAMING
- A. Single-Source Responsibility for Steel Framing: Obtain steel framing members from a single manufacturer, unless otherwise noted.
1. Furnish framing materials in accordance with SSMA – Product Technical Information.
- B. Code-Compliance Certification of Studs and Tracks: Provide certification of code compliance of studs and track that framing members are certified in accordance with product certification program of:
1. CSSA: Certified Steel Stud Association.
 2. SFIA: Steel Framing Industry Association.
 3. SSMA: Steel Stud Manufacturer's Association.
- C. Fire – Test Response Characteristics: Where fire-resistance-rated gypsum board assemblies are indicated, provide assemblies that comply with the following requirements:
1. Provide materials and construction identical to those tested in assembly

indicated, according to ASTM E119 by an independent testing agency.

2. Dynamic Head-of-Wall Assemblies (HW-D): Vertical deflection assemblies provided in fire-resistance-rated assemblies as indicated, labeled and listed by UL, Warnock Hersey or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in an assembly indicated, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- E. Perform work in accordance with ASTM C754.
- F. Installer qualifications: Company specializing in performing the work of this Section with minimum 5 years of experience.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Protect metal framing from corrosion, deformation and other damage during delivery, storage and handling.
- B. Store metal framing, protect with a waterproof covering and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers for Interior (Drywall) Studs: Subject to compliance with requirements, provide metal framing by one of the following:
 1. ClarkDietrich Building Systems
 2. Marino/Ware – A Division of Ware Industries
 3. The Steel Network, Inc.
- B. Basis-of-Design Product: The design for connecting devices for interior (drywall) framing is based on The Steel Network, Inc.

Subject to compliance with requirements, provide named product or a comparable product by:

1. ClarkDietrich Building Systems.

2.02 INTERIOR (DRYWALL) FRAMING

- A. General: Provide steel framing members complying with IBC 2015, ASTM C645 Section 10 and AISI S220 and the following requirements:

1. Provide G60 hot-dip galvanized coating where framing members are in direct contact with masonry or concrete surfaces.
 2. Protective Coating: ASTM A653, G40 hot-dip galvanized coating.
- B. Steel Studs and Runners: IBC 2015, ASTM C645 Section 10 and AISI S220, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch-wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:
1. Thickness: 30 mil (20-gauge Drywall), minimum thickness, 0.0296 inches, design thickness 0.0312-inch, minimum yield, 33 ksi.
 2. At walls with ceramic tile provide: 33 mil (20 gauge Structural), minimum thickness 0.0329 inches, design thickness 0.0346-inch minimum yield, 33 ksi.
 3. Depth: As indicated.
 4. Track: 1-1/4 inches. Gauge of track to match stud gauge unless otherwise noted.
- C. Deflection Clips: 1-1/2 inches by 3 inches slotted leg by 33 mils VertiClip SLD angle or VertiTrack VTD as manufactured by The Steel Network. Width of clip to match depth of stud. Clip shall be manufactured from steel conforming to ASTM A653A, Grade 50, Class 1, 50 KS1 minimum yield strength, 65 KS1 minimum tensile strength, G-60 hot-dipped galvanized coating. Clips shall be designed for positive attachment to structure and stud web using step bushing to provide frictionless vertical movement. Provide clips with attached bushing and screws. At sloping beams and roof deck, bend horizontal leg as required so that vertical leg remains plumb. Use only deflection connection products that comply with ICC Acceptance Criteria AC261 such as Report No. ESR-1903 (or equivalent). Site fabricated clips are not permitted.
1. Alternate Deflection Track: MaxTrak (SLT) Slotted Track as manufactured by ClarkDietrich. Substitutions permitted according to the Conditions of the Contract and appropriate Division 01 Sections. At fire rated partitions provide a top runner that allows the partition head to expand and contract with movement of the structure while maintaining continuity of the fire-resistance-rated assembly indicated, in thickness not less than indicated for studs and in a width to accommodate depth of the studs. Comply with UL 2079. Refer to Section 07 84 00 Firestopping for approved fire stop materials.
 - a. Product Type: ASTM C955.
 - b. Material Specifications: ASTM A1003/A1003M Structural Grade 33 Type H, (ST33H): 33ksi minimum yield strength, 45ksi minimum tensile strength, 33 mil minimum thickness (20-gauge, 0.0329-inch Min. Thickness, 0.0346-inch design thickness,) with ASTM C955 CP60 coating.
- D. Flat Steel Plate: Steel sheet complying with ASTM A653 or ASTM A568 with minimum base metal thickness as follows:
1. Thickness:
 - a. 54 mils, (16 gauge) minimum thickness 0.0538 inches, 33 ksi steel.

2. Width: 6 inches, unless noted otherwise.
 3. Length: 10 feet.
- E. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.
- F. Clip Angles: 30 mils, (20 gauge) minimum thickness 0.0296 inches, 33 ksi steel. Size as shown on Drawings.
- G. Bridging:
1. Bridging: BridgeBar 75 as manufactured by The Steel Network or approved equal.
- H. Radiused track: Galvanized track G60 coating in accordance with ASTM A653, 30 mil, minimum thickness 0.0296 inches, 2 ½, 3 5/8 inch and 6 inches Flex-C Trac with galvanized sliding steel strap as manufactured by Flex-Ability Concepts.
- I. Utility Angles: Used to connect, reinforce and secure metal stud framing.
1. Size: As shown on Drawings.
 2. Thickness: 30 mils, (20 gauge) minimum 0.0296 inches, unless otherwise noted on Drawings.

2.03 ANCHORS, CLIPS AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36, zinc coated by the hot-dip process according to ASTM A123.
- B. Powder-Actuated Anchors: Federal Specification FF-P-395b. Manufactured from AISI 1062 or 1065 steel, austempered to a minimum core hardness of 50 to 54 HRC and zinc plated in accordance with ASTM B 633. Provide fasteners listed or approved by one or more of the following and of type, diameter and length as required by structural design calculations:
1. Underwriters Laboratory.
 2. Factory Mutual.
 3. International Code Council (ICC).
- C. Mechanical Fasteners: Corrosion-resistant coated, self-drilling, self-threading steel drill screws. Provide screw type and size as required by structural design calculations for the specific condition and thickness of materials being joined.
1. Head Type: Low profile head beneath sheathing, manufacturer's standard elsewhere.

2.04 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

2.05 FABRICATION

- A. Fabricate metal framing and accessories plumb, square, true to line, and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
 - 1. Fabricate framing assemblies in jig templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten metal framing members by screw fastening as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to metal framing manufacturer's instructions with screw penetrating jointed members by not less than 3 exposed screw threads.
 - 4. Fasten other materials to metal framing by bolting, or screw fastening according to manufacturer's recommendations.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.
- C. Fabrication Tolerances: Fabricate assemblies to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
 - 2. Squareness: Fabricate each metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 EXECUTION

3.01 INSPECTION

- A. Verify that building framing components are ready to receive work.
- B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION – GENERAL

- A. Install metal framing and accessories plumb, square, true to line and with connections securely fastened, according to manufacturer's recommendations and the requirements of this Section.
 - 1. Cut framing members by sawing or shearing; do not torch cut.

2. Fasten metal framing members by screw fastening, as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Locate mechanical fasteners and install according to metal framing manufacturer's instructions with screw penetrating joined members by not less than 3 exposed screw threads.
- B. Install framing members in one-piece lengths, unless splice connections are indicated for track or tension members.
- C. Provide temporary bracing and leave in place until framing is permanently stabilized.
- D. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.
- E. At all locations where multiple studs and tracks occur, fasten studs and tracks together at maximum 24-inch o.c.

3.03 INSTALLATION – INTERIOR (DRYWALL) STEEL FRAMING

- A. Examine substrates to which gypsum board assemblies attach or abut, installed hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until satisfactory.
- B. Steel Framing Installation Standard: Install steel framing to comply with ASTM C754 and with ASTM C840 requirements that apply to framing installation.
- C. Install supplementary framing, blocking and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, wall protection or similar construction. Comply with details indicated and with recommendations of gypsum board manufacturer or, if none available, with United States Gypsum Co.'s "Gypsum Construction Handbook."
 1. Coordinate with Section 06 10 53 – Miscellaneous Carpentry for rigid wall backing plates at locations specified.
 2. Coordinate with Section 09 21 16 – Gypsum Board Assemblies for steel backing plate behind aluminum trim and reveals.
 3. Coordinate with Section 10 26 00 – Wall Protection for metal stud blocking:
 - a. Corner guards.
 - b. Chair rails.
- D. Isolate steel framing from building structure and underside of roof deck at locations indicated to prevent transfer of loading imposed by structural movement. Comply with details shown on Drawings.
- E. Do not bridge building control and expansion joints with steel framing or furring members. Independently frame both sides of joints with framing or furring members as indicated.

- F. Install runners (tracks) at floors, top of partitions, ceilings and structural walls and columns where gypsum board stud assemblies abut other construction.
- G. Installation Tolerances: Install each steel framing and furring member so that fastening surface do not vary more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.
- H. Extend partition framing full height to structural supports, underside of roof deck, except where partitions are indicated to terminate above suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.
 - 1. At deflection clips, cut studs 1/2 inch short of full height to provide perimeter relief.
 - 2. STC-rated and fire-resistance-rated partitions that extend to the underside of roof decks or other continuous solid structural surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed, to support gypsum board closures needed to make partitions continuous from floor to underside of solid structure.
- I. Install steel studs and furring in sizes and at spacings indicated.
 - 1. Single-Layer Construction: Space studs 16 inches o.c., unless otherwise indicated.
- J. Install steel studs so flanges point in the same direction and leading edge or end of each gypsum board panel can be attached to open (unsupported) edges of stud flanges first.
- K. Frame door, borrowed light, and cased openings with minimum two studs and one nested track. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames.
 - 1. At jambs install two channel shaped metal studs and one metal track. The metal track shall be nested within the metal stud as shown. Boxed stud and track shall be screw attached together using #10-16 screws at maximum 24 inches o.c. Attach second stud to boxed stud/track using #10-16 screws at maximum 24 inches o.c.
 - 2. At the frame head, provide a steel track for openings up to 3'-0" wide. For openings wider than 3'-0" provide box header.
 - 3. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint.
- L. Frame openings, other than door openings, to comply with details indicated or, if not indicated, as required for door openings. Install framing below sills of openings to match framing required above door heads.
- M. Coordinate installation of wood bucks, anchors and wood blocking with electrical and mechanical work to be placed within or behind stud framing.
- N. Blocking: Coordinate with Section 06 10 53 – Miscellaneous Carpentry.

- O. Coordinate placement of insulation in stud spaces made inaccessible after stud framing erection.
- P. Horizontal Bridging: At the following partitions install bridge bar or approved equal to each stud spaced as follows:
 - 1. Non-Composite-Fully Braced where the gypsum wall board on both sides stops at or just above the ceiling and the stud continues to deck. Spacing of horizontal bridging shall be based on the Lu (critical unbraced length for lateral-torsional buckling) shown in the schedule titled "Interior Wall Heights-Non-Composite-Fully Braced"
 - 2. Non-Composite-Braced where the stud framing and gypsum wallboard on one side of the wall stops at the deck. Spacing of horizontal bridging shall be at maximum 48 inches on center
- Q. Radiused Track: Install radiused track in accordance with manufacturer's instructions. Splice track segments by overlapping bands from one track to another and attaching screwed fasteners at overlapping plates or flange intervals. Screw penetrations of not less than 3 exposed screw threads. Fasten reinforcement plate over web penetrations that exceed size of manufacturer's standard punched openings.

3.04 SCHEDULE

- A. Maximum Variation from Plumb, Level and True Position: 1/8 inch in 10 feet.

SCHEDULE (NOTE: Table was taken from the SSMA Product Technical Guide).

- B. Interior Wall Heights-Composite, based on maximum allowable deflection of L/240 span, with a minimum load of 5 pounds per square foot applied perpendicular to walls.

Composite limiting heights are based on a single layer of 5/8 inch Type X gypsum board installed in the vertical orientation to both sides of the wall over the full height using minimum No. 6 Type S drywall screws spaced a maximum of 16 inches on center but not less than the spacing noted in Section 09 21 16 Gypsum Board Assemblies for rated and non-rated partitions.

At interior partitions that include an STC rating install studs at 16 inches on center.

1.	Stud	Spacing	Height Limitation
	162S125-30	12"	11'-10"
	162S125-30	16"	10'-9"
	250S125-30	12"	15'-10"
	250S125-30	16"	14'-5"
	362S125-30	12"	18'-3"
	362S125-30	16"	16'-7"
	600S125-30	12"	27'-1"
	600S125-30	16"	24'-7"

- C. Interior Wall Heights-Non-Composite-Fully Braced, based on maximum allowable

deflection of L/240 span, with a minimum load of 5 pounds per square foot applied perpendicular to walls.

NOTE: Limiting heights listed below are based on steel properties only (non-composite) without contribution of sheathing. Properly fastened sheathing required to be considered fully braced.

Non-Composite-Fully Braced limiting heights are based on the gypsum board on both sides of the partition stopping at or above the ceiling and the stud framing continues to deck and the distance between the deck and the top of the gypsum board is limited to Lu (Critical unbraced length for lateral-torsional buckling). Members are also considered fully braced, using horizontal bridging as specified in this section installed within 12 inches from the top track and the distance between the bridging and the top of the gypsum board is less than Lu)

1.	Stud	Spacing	Height Limitation	Lu (inches)
	162S125-30	12"	9'-3"	29.2
	162S125-30	16"	8'-5"	29.2
	250S125-30	12"	12'-9"	28.9
	250S125-30	16"	11'-7"	28.9
	362S125-30	12"	17'-0"	28.6
	362S125-30	16"	15'-6"	28.6
	600S125-30	12"	25'-2"	27.6
	600S125-30	16"	22'-11"	27.6

- D. Interior Wall Heights-Non-Composite-Braced at 48 inches o.c., based on maximum allowable deflection of L/240 span, with a minimum load of 5 pounds per square foot applied perpendicular to walls.

Non-Composite-Braced at 48 inches o.c. limiting heights are based on the stud framing along with the gypsum board on one side of the wall stopping at the floor/roof deck and the distance between the horizontal bracing is 48 inches o.c. maximum and the horizontal bridging is installed within 12 inches of the top track.

1.	Stud	Spacing	Height Limitation
	162S125-30	12"	9'-3"
	162S125-30	16"	8'-5"
	250S125-30	12"	12'-10"
	250S125-30	16"	11'-8"
	362S125-30	12"	17'-1"
	362S125-30	16"	15'-6"
	600S125-30	12"	25'-4"
	600S125-30	16"	23'-0"

- E. Ceramic Tile: Minimum 3 5/8 inch metal studs.

Interior Wall Heights-Non-Composite based on maximum allowable deflection of L360 span, with a minimum load of 5 pounds per square foot applied perpendicular to walls.

Non-composite limiting heights are based on the properties of stud framing alone.

1.	Stud	Spacing	Height Limitation
	362S125-33	12"	15'-4"
	362S125-33	16"	14'-0"
	600S125-33	12"	22'-10"
	600S125-33	16"	20'-9"

END OF SECTION

SECTION 09 30 00 – TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall Tiles.
- B. Floor Tile.
- C. Setting Materials.
- D. Tile Accessories.
- E. Waterproofing Membranes.
- F. Sealants.

1.02 RELATED SECTIONS

- A. Section 01 40 00 – Quality Requirements.
- B. Section 01 45 23 – Concrete In-Situ Relative Humidity and pH Testing:
- C. Section 01 45 29 – Testing Laboratory Services.
- D. Section 03 30 00 – Cast-In-Place Concrete: Preparing floor slab for tile application.
- E. Section 07 90 00 – Joint Protection: Sealants installed at movement joints.
- F. Section 09 21 16 – Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. Installation Specifications:
 - 1. ANSI A108 Series/A118 Series/A136.1 – American National Standard Specifications for the Installation of Ceramic Tile (Compendium of the following).
 - a. ANSI A108.1B-2010 – Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dryset or Latex Portland Cement Mortar.
 - b. ANSI A108.5-2010 – Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Mortar (not published separately).
 - c. ANSI A108.6-2010 – Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy.
 - d. ANSI A108.13-2016 – Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
- B. Material Specifications:
 - 1. ANSI A118.3-2013 – Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive.

2. ANSI A118.4-2018 – Latex Modified Portland Cement Mortar (not published separately).
3. ANSI A118.10-2014 – Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installations.
4. ANSI A118.15-2018 – Improved Latex Modified Cement Mortars.
5. ANSI A137.1-2017 – American National Standard Specifications for Ceramic Tile.
6. ANSI A137.2-2013 – American National Standard Specifications for Glass Tile.
7. TCNA – (Tile Council of North America) Handbook for Ceramic, Glass and Stone Tile Installation, Current Edition.

C. ASTM:

1. ASTM C373 – Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity and Apparent Specific Gravity of Fired Whiteware Products.
2. ASTM C648 – Standard Test Method for Breaking Strength of Ceramic Tile.
3. ASTM C650 – Standard Test Method for Resistance of Ceramic Tile to Chemical Substances.
4. ASTM D5957 – Standard Guide for Flood Testing Horizontal Waterproofing Installation.

D. ISO – International Organization of Standardization

1. 13007 Standards for Adhesives and Grouts.

1.04 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide product data and installation instructions for the following materials:

1. Floor tiles.
2. Wall tiles.
3. Waterproof membranes.
4. Mortar bond coat materials.
5. Grout materials.
6. Tile accessories.
7. Cleaners and sealers.

8. Sealants.

C. Samples:

1. Provide digital image and product information for verification of Basis of Design products.

D. Manufacturer's Certificate: Each product manufacturer furnishing products under this section shall certify in writing that the products are recommended for the intended use.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 70 00 – Execution and Closeout Requirements.

B. Maintenance Data: Include recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.06 QUALITY ASSURANCE

A. Comply with applicable parts of ANSI A108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile."

B. Comply with applicable parts of Tile Council of America (TCA) "Handbook for Ceramic Tile Installations," Latest Edition.

C. Single-Source Responsibility for Tile: Obtain each color, grade, type, composition and variety of tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying progress of the work.

D. Single-Source Responsibility for Setting and Grouting Materials: Obtain ingredients of a uniform quality from one manufacturer for each, epoxy and admixture component and from one source or producer for each aggregate.

E. Installer Qualifications: Engage an experienced Installer who has successfully completed tile installations similar in material, design and extent to than indicated for Project.

1.07 DELIVERY, STORAGE AND HANDLING

A. Section 01 30 00 – Administrative Requirements.

B. Deliver and store packaged materials in original containers with seals unbroken and label intact until time of use. Comply with requirements of ANSI A137.1 for labeling sealed tile packages.

C. Prevent damage or contamination to materials by water, freezing, foreign matter and other causes.

D. Handle tile with temporary protective coating on exposed surfaces to prevent coated services from contacting backs or edges of other items. If despite these precautions coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.08 PROJECT CONDITIONS

- A. Section 01 60 00 – Product Requirements.
- B. Maintain environmental conditions and protect work during and after installations to comply with referenced standards and manufacturer's printed recommendations.
- C. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide buildup.
- D. Maintain temperatures at 50 degrees F (10 degrees C) or more in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

1.09 PRE-INSTALLATION MEETINGS

- A. Convene four weeks prior to commencing work of this section, under provisions of Section 01 30 00 – Administrative Requirements: Pre-installation meeting.

DO NOT PROCEED WITH THE INSTALLATION OF THE TILE AND WATERPROOFING MEMBRANE, IF APPLICABLE, PRIOR TO THE PRE-INSTALLATION MEETING.

DO NOT PROCEED WITH THE PRE-INSTALLATION MEETING IF ANY ONE OF THE FOLLOWING PARTIES IS NOT IN ATTENDANCE:

**INSTALLER
OWNER'S REPRESENTATIVE (IF APPLICABLE)
ARCHITECT
GENERAL CONTRACTOR
PLUMBING CONTRACTOR, IF APPLICABLE**

PART 2 PRODUCTS

2.01 MANUFACTURERS/PRODUCTS/COLORS

- A. Manufacturers: Refer to the "List of Finishes" located on the Drawings for a list of manufacturer's, products and colors for wall tiles, and floor tiles on the floors and walls.

2.02 PRODUCTS – GENERAL

- A. ANSI Standard for Ceramic Tile: Comply with ANSI A137.1 "American Standard Specifications for Ceramic Tile" for types, compositions and grades of tile indicated.
 - 1. Furnish tile complying with "Standard Grade" requirements unless otherwise indicated.
- B. Water Absorption, ASTM C373
 - 1. Impervious – Tiles exhibiting 0.5% or less.
 - 2. Vitreous – Tiles exhibiting more than 0.5% but not more than 3.0%.
 - 3. Semi-Vitreous – Tiles exhibiting more than 3.0% but not more than 7.0%.
 - 4. Non-Vitreous – Tile exhibiting more than 7.0%.

- C. ANSI Standard for Tile Installation Materials: Comply with ANSI standard referenced with products and materials indicated for setting and grouting.
- D. Coefficient of Friction:
 - 1. Per ANSI A137.1-2012, ceramic tile selected for level interior spaces expected to be walked upon when wet shall have a minimum wet DCOF AcuTest value of 0.42.
- E. Colors, Textures and Patterns: Where manufacturer's standard products are indicated for tile, grout and other products requiring selection of colors, surface textures, patterns and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Match color, texture and pattern indicated by reference to manufacturer's standard designations for these characteristics.
 - 2. Provide tile trim and accessories that match color and finish of adjoining tile.
- F. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in factory and package accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.
- G. Where factory-mounted tile is specified, provide back- or edge-mounted tile assemblies methods as standard with manufacturer unless another mounting method is indicated.
 - 1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies that this type of mounting is suitable for these kinds of uses and has been successfully used on other projects.

2.03 TILE PRODUCTS

- A. Refer to "List of Finishes" as shown on the Drawings for each wall tile, and floor tile product specified including manufacturer, composition, size, thickness and color.
- B. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:
 - 1. Size and shapes: As indicated on the Drawings and in the "List of Finishes."
 - 2. Shapes: As follows, selected from manufacturer's standard shapes:
 - a. Internal corners: Field-buttet square corners, except use cove base and cap angle pieces designed to member with stretcher shapes.
 - b. Floor edge protection: Cove shaped profile.

2.04 TILE ACCESSORIES

- A. Floor Edge Protection: Schluter profile as shown on Drawings Sizes: Verify H dimension with specified tile prior to bidding.
 - 1. Sizes: Verify H dimension with specified tile prior to bidding.

- a. AE 100, H = 3/8 inch
 - b. AE 125, H = 1/2 inch
2. Provide appropriate size (height) for transitioning from specified tile floor material to adjacent dissimilar floor.
- B. Edge Protection for Tiled Edges and Outside Corners: Schluter profile as shown on Drawings
1. Sizes: Verify H dimension with specified tile prior to bidding.
 - a. Color(s) as selected by Architect
 2. Provide inside and outside corners and connectors.
- C. Cove Shaped Profile: Schluter profile as shown on Drawings.
1. Sizes: Verify H dimension with specified tile prior to bidding.
 - a. AHK 1S 100, H = 3/8 inch
 - b. AHK 1S 125, H = 1/2 inch
 2. Provide 90 degree inside and outside corners, connectors and end caps.

2.05 WATERPROOFING FOR THIN-SET TILE INSTALLATIONS

- A. Fluid Applied Waterproofing/Crack Isolation Membrane: Manufacturer's standard factory-prepackaged, job-mixed, proprietary self-curing fluid and reinforcing fabric which meets ANSI A118.10 and is IAPMO listed for use as a waterproofing shower pan liner.
1. Fluid Applied Waterproofing
 - a. Laticrete Hydroban waterproof membrane; Laticrete International, Inc.
 - 1) VOC content: 2.39 g/L.
 - b. Mapelastic AquaDefense; Mapei
 - 1) VOC content: 0 g/L.
 - c. 8 + 9 Rapid waterproofing and crack- isolation; Ardex Americas.
 - 1) VOC content: 0 g/L.
 - 2) SK mesh reinforcing fabric and SK Drain tie in fabric.

2.06 SETTING MATERIALS

- A. Latex-Portland Cement Mortar: Provide products from the following manufacturers and complying with the ANSI and ISO 13007 standards indicated. Note: The use of organic adhesives complying with ANSI A136.1 will not be allowed.
1. Provide products for setting the following types of tiles:
 - a. Ceramic.
 - b. Porcelain.
 - c. Stone (dimensionally stable).

- d. Mosaic tile.
- 2. Product/Manufacturer:
 - a. Ultraflex 2/Mapei Corporation
 - 1) Standards: ANSI A118.4 and ISO 13007 Classification C2EP1.
 - 2) VOC content: 0 g/L.
 - b. 253 Gold/Laticrete International, Inc.
 - 1) Standards: ANSI A118.4 and ISO 13007 Classification C2
 - 2) VOC content: 0 g/L.
 - c. Ardex X4/Ardex Americas.
 - 1) Standards: ANSI A118.4 and ISO 13007 Classification C2TE.
 - 2) VOC content: 0 g/L.
- B. Latex-Portland Cement Mortar: Provide products from the following manufacturers and complying with the ANSI and ISO 13007 standards indicated. Note: The use of organic adhesives complying with ANSI A136.1 will not be allowed.
 - 1. Provide products for setting the following types of tiles:
 - a. Tiles weighing more than 5 pounds per square foot.
 - b. Setting larger tiles, tiles with at least one edge greater than 15 inches long.
 - 2. Product/Manufacturer:
 - a. Ultraflex LFT/Mapei Corporation
 - 1) Standards: ANSI A118.4 and ISO 13007 Classification C2TES1P1.
 - 2) VOC content: 0 g/L.
 - b. 4-XLT/Laticrete International, Inc.
 - 1) Standards: ANSI A118.4, A118.15 and ISO 13007 C2TES2
 - 2) VOC content: 2.56 g/L.
 - c. Ardex X5/Ardex Americas
 - 1) Standards: ANSI A118.4 and ISO 13007 C2TE.
 - 2) VOC content: 0 g/L.

2.07 GROUTING MATERIALS

- A. Commercial grade water-cleanable epoxy grout: ANSI A118.3 and ISO 13007 Classification R2/RG, R2: Reaction Resin Adhesive, improved, RG: Reaction Resin Grout; color(s) as selected from manufacturer's standard colors.
 - 1. Use: All locations floors and walls unless noted otherwise, for grout joints 1/16 inch to 3/8 inch
 - 2. Product/Manufacturer:
 - a. Kerapoxy CQ/Mapei Corporation

- 1) Standards: ANSI A118.3 and ISO 13007 Classification R2/RG.
 - 2) VOC content: 8 g/L.
- b. SpectraLOCK Pro Premium/Laticrete International, Inc.
- 1) Standards: ANSI A118.3 and ISO 13007 Classification RG and EN.
 - 2) VOC content: 0.031 g/L.
- c. Ardex WA epoxy/Ardex Americas.
- 1) Standards: ANSI A118.3 and ISO 13007 R2T RG.
 - 2) VOC content: 2.67 g/L.

2.08 CLEANERS/SEALERS

- A. Sealer: Tile sealer as recommended by tile manufacturer for sealing natural stone and unglazed ceramic tile..
1. Product/Manufacturer:
 - a. UltraCare Penetrating Plus Stone, Tile & Grout Sealer/Mapei Corporation.
 - 1) VOC Content: 45 g/L.
 - b. StoneTech BulletProof Sealer/Laticrete International, Inc.
 - 1) VOC Content: 20 g/L.
 - c. FILA Surface Care Solutions: Product approved by Ardex Americas for use with Ardex specified materials.

2.09 PRIMERS

- A. For gypsum-based walls, provide primer recommended by manufacturer of setting materials.

2.10 SEALANTS

- A. Sealant shall comply with ASTM C920, Single, Multi-Component or Pourable, Use T, Uses M and G as recommended by tile manufacturer for sealing joints in floor tile. Color of sealant to match grout color.
1. Product/Manufacturer:
 - a. Mapesil T/Mapei Corporation
 - 1) VOC content: 44 g/L.

2.11 MIXING MORTAR AND GROUT

- A. Mix mortars and grouts to comply with requirements of referenced standards and manufacturers including those for accurate proportioning of materials, water, or additive content, type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortars and grouts of uniform quality with optimum performance characteristics for application indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and areas where tile will be installed, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm, dry, clean and free from oil or waxy films and curing compounds.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile have been completed before installing tile.
 - 3. New concrete surfaces shall be mechanically prepared to a minimum ICRI (International Concrete Repair Institute) CSP #3 to CSP #5. **Note:** Installing tile over troweled surfaces is not permitted.
- B. Verify concrete floors are dry to a maximum moisture content allowed by flooring manufacturer and exhibit negative alkalinity, carbonization or dusting.
 - 1. Relative Humidity Test Method: Perform humidity testing using in situ probes in accordance with ASTM F2170.
 - a. Waterproofing Membranes: Maximum moisture in concrete/mortar bed shall not exceed 75 percent relative humidity unless otherwise noted by the manufacturer.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in factory and packaged accordingly so that tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.03 INSTALLATION – GENERAL

- A. ANSI Tile Installation Standard: Comply with parts of ANSI 108 Series of Tile Installation Standards included under “American National Standard Specifications for the Installation of Ceramic Tile” that apply to type of setting and grouting materials and methods indicated.
- B. TCNA Installation Guidelines: TCNA “Handbook for Ceramic, Glass and Stone Tile

Installation"; comply with TCNA Installation Methods indicated.

- C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions except as otherwise shown. Terminate work neatly at obstructions, edges and corners without disrupting patterns or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, or built in items for straight aligned joints. Fit tile close to electrical outlets, piping fixtures, and other penetrations so that plates and covers overlap tile.
- E. Jointing Pattern: Unless otherwise shown, lay tile in grid pattern. Align joints when adjoining tiles on the floor, base and walls are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall. Adjust to minimize tile cutting. Provide uniform widths unless otherwise shown.
- F. Lay out tile wainscots to next full tile beyond dimension indicated.
- G. Grout tile to comply with the requirements of the following installation standards:
 - 1. For epoxy grouts, comply with ANSI A108.6.
- H. Allow tiles to set firmly for 48 hours before grouting.
- I. Prime surfaces as required using materials recommended by manufacturer of setting materials.
- J. Tile accessories:
 - 1. Floor edge protection: Provide floor edge between dissimilar flooring types
 - 2. Edge protection for Tiled Edges and Outside Corners: Refer to drawings for location of edge protection.
 - 3. Cove Shaped Profile: Provide cove shaped tile or Schluter profile at all floor tile to wall tile transitions.

3.04 WATERPROOFING INSTALLATION

- A. Install waterproofing membrane in compliance with waterproofing manufacturer's instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate. Install all required flashings at corners and wall to floor edges.
 - 1. Extend waterproofing membrane up walls a minimum of 3 inches.
 - 2. At showers coat all vertical walls covered with tile. Refer to applicable TCNA number.
- B. Do not install mortar bed and or tile over waterproofing until waterproofing has been tested in accordance with ASTM D5957 to determine that it is watertight.

3.05 FLOOR, INTERIOR – INSTALLATION METHODS, THIN-SET LOAD-BEARING WATERPROOF MEMBRANE, OVER BONDED MORTAR BED (FOR SLAB-ON-GROUND CONSTRUCTION

WHERE BENDING STRESS DOES NOT OCCUR)

Mortar Bed: Install tile to comply with requirements indicated below for setting bed methods, TCNA installation methods related to types of subfloor construction, and group types:

1. Portland Cement Mortar Bed: ANSI A108.1B – Installation of Ceramic Tile on a Bonded Cured Portland Cement Mortar Bed with Dryset or Latex Portland Cement Mortar.
 - a. Concrete subfloors, interior, bonded waterproof membrane: Installed over concrete or cured mortar bed:
 - 1) TCNA F112.
 - 2) Mortar Bed, ANSI A108.1B required with membrane.
 - 3) Waterproof Membrane: ANSI A108.13.
 - 4) Bond Coat: Latex-Portland Cement Mortar, ANSI A108.5.
 - 5) Grout: Epoxy Grout, ANSI A108.6.
 - b. Concrete subfloors, interior, curbless shower receptor, coated glass mat water-resistant gypsum tile backer board:
 - 1) TCNA B422C-Curbless Shower Receptor
 - 2) Mortar Bed Reinforcing, ANSI A108.1B.
 - 3) Waterproof Membrane: ANSI A108.13. Waterproof membrane shall be bonded to mortar bed.
 - 4) Bond Coat: Latex-Portland Cement Mortar, ANSI A108.5.
 - 5) Grout: Epoxy Grout, ANSI A108.6.

3.06 FLOOR, INTERIOR – INSTALLATION METHODS, THIN-SET LOAD-BEARING WATERPROOF MEMBRANE, OVER CONCRETE FLOORS (FOR SLAB-ON-GROUND CONSTRUCTION WHERE BENDING STRESS DOES NOT OCCUR)

- A. Concrete: Install tile to comply with requirements indicated below for setting bed methods, TCNA installation methods related to types of subfloor construction and group types:
 1. Concrete subfloors, interior, bonded waterproof membrane: Installed over concrete:
 - a. TCNA F122
 - b. Waterproof Membrane: ANSI A108.13
 - c. Bond Coat: Latex-Portland Cement Mortar, ANSI A108.5.
 - d. Grout: Epoxy Grout, ANSI A108.6.

3.07 WALL TILE, INTERIOR – INSTALLATION METHOD, SHOWER WALLS (WET AREA)

- A. Install types of tile designated for wall applications to comply with requirements indicated below for setting-bed methods, TCNA installation methods related to subsurface wall conditions and grout types.
 1. Thin-Set Mortar:
 - a. Shower Walls, Interior, Metal Stud.

- 1) Coated Glass Mat Water Resistant Gypsum Tile Backer Board over Metal Studs: TCA W245
 - 2) Waterproof membrane: ANSI A108.13. Coat all vertical surfaces scheduled to receive tiles.
 - 3) Bond Coat: Latex-Portland Cement Mortar, ANSI A108.5.
 - 4) Grout: Epoxy Grout, ANSI A108.6.
- b. Shower Receptor: Concrete subfloors, interior, shower receptor, coated glass mat water-resistant gypsum tile backer board:
- 1) TCNA B422C-Curbless Shower Receptor.
 - 2) Mortar Bed Reinforcing, ANSI A108.1B.
 - 3) Waterproof Membrane: ANSI A108.13. Waterproof membrane shall be bonded to mortar bed.
 - 4) Bond Coat: Latex-Portland Cement Mortar, ANSI A108.5.
 - 5) Grout: Epoxy Grout, ANSI A108.6.
- 3.08 WALL TILE, INTERIOR – INSTALLATION METHOD OVER COATED GLASS MAT WATER-RESISTANT GYPSUM BACKER BOARD (DRY AREA)
- A. Install types of tile designated for wall applications to comply with requirements indicated below for TCNA installation methods related to subsurface wall conditions and grout types.
1. Thin-Set Mortar:
 - a. Walls, Interior
 - 1) Coated Glass Mat Water Resistant Gypsum Tile Backer Board over Metal Studs: TCNA W245
 - 2) Bond Coat: Latex-Portland Cement Mortar, ANSI A108.5.
 - 3) Grout: Epoxy Grout, ANSI A108.6.
- 3.09 MOVEMENT JOINTS
- A. Perimeter Joint
1. TCNA EJ171G at thin-set installations.
 2. TCNA EJ171I at mortar bed installations.
 3. Provide sealant, matching color of grout and bond breaker tape, around the perimeter of the tile floor.
- B. Contraction and Construction Joint
1. TCNA EJ171A at mortar bed installation.
 2. TCNA EJ171B at thin-set installation.
 3. Provide sealant, matching color of grout and backer rod or bond breaker tape.
- C. Vertical movement joint in tile and backer board and wall framing.

1. TCAN EJ171K

3.10 CLEANING

- A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter, in conformance with tile and grout manufacturer's instructions.
 1. Clean tile using epoxy grout film remover, in accordance with manufacturer's instructions.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded and otherwise defective tile work.
- C. Provide final protection and maintain conditions in a manner acceptable to manufacturer and installer that ensures that tile is without damage or deterioration at time of Substantial Completion.
- D. Seal tile and grout with sealer in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical ceiling panels.
- C. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and perimeter trim.

1.02 RELATED SECTIONS

- A. Section 23 37 00 – Air Outlets and Inlets: Air diffusion devices in ceiling system.
- B. Section 26 51 00 – Interior Lighting: Light fixtures in ceiling systems.
- C. Section 27 51 16 - Public Address and Mass Notification Systems: Speakers in ceiling systems.
- D. Section 28 31 00 – Fire Detection and Alarm: Fire alarm components in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASTM A1008 – Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
- B. ASTM A641 – Standard Specification for Zinc-Coated (Galvanized) Carbon steel Wire.
- C. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- D. ASTM C423 – Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- E. ASTM C635 – Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- F. ASTM C636 – Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
- G. ASTM E84-94 – Standard Test Method for Burning Characteristics of Building Materials.
- H. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials.
- I. ASTM E1414 – Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
- J. ASTM E1264 – Classification of Acoustical Ceiling Products.

K. ANSI Standard S12.60 -2010/Part 1. Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools Part 1: Permanent Schools.

L. CISCA – Acoustical Ceilings: Use and Practice.

1.04 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures.

B. Product Data: Provide data on metal grid system components and acoustical units.

C. Samples: Submit two samples full size 6 x 6 inch in size illustrating material and finish of each acoustical unit specified.

D. Provide 12-inch-long samples of each metal grid system specified.

1.05 QUALITY ASSURANCE

A. Conform to CISCA Requirements.

B. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

1.06 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years of recommended experience.

B. Installer: Company specializing in performing work of this section with minimum five years of documented experience.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Maintain uniform temperature and humidity levels as recommended by the manufacturer prior to, during and after acoustical unit installation.

1.08 EXTRA MATERIALS

A. Section 01 70 00 – Execution and Closeout Requirements.

B. Provide 1 percent of total acoustical unit area of extra tile panels to Owner of each panel type specified.

C. Provide 1 percent of exposed suspension system to Owner of each grid type specified.

1.09 SEQUENCING

A. Sequence work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust-generating activities have terminated, and overhead work is completed, tested and approved.

B. Install acoustic units after interior work is dry.

1.10 WARRANTY

- A. Refer to each product specified for warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS – SUSPENSION SYSTEM

- A. Armstrong.
- B. USG.
- C. CertainTeed.

2.02 SUSPENSION SYSTEM MATERIALS

- A. Non-Fire-Rated Grid: ASTM C635, intermediate duty; hot-dipped galvanized. Exposed grid surface width shall be 15/16, "Prelude XL" as manufactured by Armstrong.
 - 1. Color: White Aluminum.
- B. Fire-Rated Grid: ASTM C635, heavy-duty; G60 hot-dipped galvanized with aluminum cap. Exposed grid surface shall be 15/16 inch, "Prelude Plus XL Fire Guard" as manufactured by Armstrong.
 - 1. Color: White Aluminum.
- C. Wall Angle Molding: 7/8 inch hemmed angle molding.
- D. Support Channels and Hangers: Galvanized steel; size and type to suit application.
- E. Select wire diameter so that the stress at 3 times the hanger load (ASTM C635, Table 1, direct hung) will be less than the yield stress of wire with a minimum requirement of 12-gauge wire.

2.03 MANUFACTURERS – ACOUSTICAL UNITS

- A. Armstrong.
- B. USG.
- C. CertainTeed.

2.04 ACOUSTICAL CEILING PANELS

- A. Acoustical Ceiling Panels conforming to ASTM E1264 and as follows:
 - 1. ACT 1: 24 inches by 24 inches by 3/4 inch anti-microbial panels, Armstrong Ultima Square Lay-In, Item No. 1910.
 - a. Composition: Mineral Fiber
 - b. NRC: 0.75

- c. CAC: 35
 - d. LR: 0.90
 - e. Sag Resistant: Humiguard+
 - f. Anti-Microbial: BioBlock+
 - g. Color: White
 - h. Recycled Materials:
 - 1) 75.1 percent pre-consumer
 - 2) 1 percent post-consumer
 - i. VOC formaldehyde: Free of formaldehyde-based resins.
 - j. Grid: Install ceiling panels with Armstrong "Prelude XL" Grid System.
 - k. Products from the following manufacturers may be submitted:
 - 1) USG: Mars ClimaPlus, Item No. 86185. Grid system to be DONN DX Suspension System.
 - 2) CertainTeed: Symphony M 75, Item No. 1222-75-1. Grid system to be 15/16 inch Classic Stab.
- ACT 2: Not Used.
2. ACT 3: 24 inches by 24 inches by 3/4 inch anti-microbial panels, Armstrong Health Zone Ultima, Item No. 1935.
- a. Composition: Mineral Fiber
 - b. NRC: 0.70
 - c. CAC: 38
 - d. LR: 0.86
 - e. Complies with USDA/FSIS for guidelines in food processing areas.
 - f. Sag Resistant: Humiguard+
 - g. Anti-Microbial: BioBlock+
 - h. Color: White
 - i. Recycled Materials:
 - 1) 76.3 percent pre-consumer
 - 2) 0 percent post-consumer
 - j. VOC formaldehyde: Free of formaldehyde-based resins.
 - k. Grid: Install ceiling panels with Armstrong "Prelude Plus XL Fire Guard" Grid System.
 - l. Products from the following manufacturers may be submitted:
 - 1) USG: Mars Healthcare, Item No. 86169. Grid system to be DONN DXLA Suspension System.
 - 2) CertainTeed: RX Symphony M, Item No. 1222-RXS-1. Grid system to be 15/16" Classic Aluminum Capped Stab System.
 - m. Location: Kitchens.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements.

- B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION – LAY-IN GRID SUSPENSION SYSTEM

- A. Install suspension systems to comply with ASTM C635 and ASTM C636, with hangers supported only from building structural members. Do not secure to metal roof deck. Locate hangers not more than 4'-0" on center along main runner direct-hung suspension system with additional hangers at ends of suspension members, at light fixtures, and 6 inches from vertical surfaces, leveling to tolerance of 1/8 inch in 12'-0".
- B. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices that are secure and appropriate for substrate, and which will not deteriorate or fail with age or elevated temperatures.
- C. Do not tie framing to:
 - 1. HVAC ductwork, sprinkler piping or conduit.
 - 2. Metal roof deck.
- D. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum which are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal force by bracing, counterplaying or other equally effective means.
- E. Install edge moldings of type indicated at perimeter of acoustical ceiling area and at locations where necessary to conceal edges of acoustical units.
- F. Screw-attach moldings to substrate at intervals not over 16 inches on center, and not more than 3" from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

3.03 LAY-IN CEILING PANELS:

- A. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members.
- B. Arrange and orient directionally-patterned units (if any) in a manner shown by reflected ceiling plans.
- C. Install in level plane and straight line courses, in accordance with Drawings and manufacturer's printed instructions.
- D. Seal joints in acoustical units around ducts, pipes, electrical outlets, etc., with acoustical sealant.
- E. Cutting Acoustic Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
- F. Where round obstructions occur, install preformed closures to match perimeter molding.

3.04 ADJUST AND CLEAN

- A. Clean soiled or discolored unit surfaces after installation. Comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Touch up scratches, abrasions, voids and other defects in painted surfaces. Remove and replace work which cannot be successfully cleaned and repaired to permanently eliminate evidence of damage. Remove and replace damaged or improperly installed units.

END OF SECTION

SECTION 09 65 00 – RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient Tile Flooring:
 - 1. Luxury Vinyl Tile.
 - 2. Rubber Tile- Alternate
- B. Resilient Sheet Flooring:
 - 1. Heterogeneous Sheet Vinyl Rubber Sheet.
- C. Resilient Base.
- D. Resilient Accessories.

1.02 RELATED SECTIONS

- A. Section 01 45 23 – Concrete In-Situ Relative Humidity and pH Testing.
- B. Section 03 30 00 – Cast-In-Place Concrete.
- C. Section 07 26 13 – Moisture Control System.

1.03 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E648 – Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source.
 - 3. ASTM E662 – Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
 - 4. ASTM F1303 – Standard Specification for Sheet Vinyl Floor Coverings with Backing.
 - 5. ASTM F1344 – Standard Specification for Rubber Floor Tile.
 - 6. ASTM F1700 – Standard Specification for Solid Vinyl Floor tile.
 - 7. ASTM F1859 – Standard Specification for Rubber Sheet Floor Covering Without Backing.

8. ASTM F1861 – Standard Specification for Resilient Wall Base.
 9. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.
- B. National Fire Protection Association:
1. NFPA 253 – Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.
 2. NFPA 258 – Test Method for Specific Density of Smoke Generated by Solid Materials.

1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns and colors available.
- C. Seaming Plan: Provide a seaming plan showing all seams.
- D. Samples:
1. Submit two samples, 6 by 6 inch in size illustrating color and pattern for each floor material for each color specified.
 2. For accessories: Manufacturer's standard-size samples, but not less than 12 inches long, of each accessory color and pattern specified.
- E. Quality Assurance Submittals: Submit the following:
1. Copies of the bond and moisture test results. A diagram of the area showing the location and results of each test shall be submitted.
 2. Manufacturer's Instructions: Current published manufacturer's installation and maintenance instructions.
- F. Submit a certificate from each flooring manufacturer specified indicating that the installer is qualified to install the specified product.

1.05 QUALITY ASSURANCE

- A. Flooring products shall be tested in accordance with ASTM E84, ASTM E648 and ASTM E662 with fire performance characteristics as follows:
1. Critical Radiant Flux per ASTM E648: .45 watts/cm², Class 1.
 2. Smoke Density per ASTM E662: Less than 450.
- B. Installer qualifications: Engage installer that is certified by floor covering manufacturer as

competent in the technique for installing flooring materials.

1. Installer shall have a minimum of five (5) years of experience installing specified products.
 2. The flooring installer shall provide an effective project manager to manage the installers and ensure that all of the required procedures are followed, documented and that the installation guides are followed as required.
- C. Manufacturer's Field Services: Upon Architect's request, each flooring manufacturer shall provide field services consisting of product use, recommendations, and periodic site visits for inspection of installation in accordance with manufacturer's instructions.
1. Site Visits: Minimum of three visits.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00 – Product Requirements.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperatures in spaces where products will be installed for time period before, during and after installation as recommended by manufacturer.

1.08 MAINTENANCE DATA

- A. Submit under provisions of Section 01 70 00 – Execution and Closeout Requirements.
- B. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping and re-waxing.

1.09 EXTRA MATERIALS

- A. Furnish to the Owner not less than one roll and/or full box, unopened, of each class, wearing surface, color, pattern and size of flooring installed.
- B. Furnish to the Owner 10 linear feet for each 500 linear feet of each different type and color of wall base installed.

1.10 SEQUENCING AND SCHEDULING

- A. Install flooring and accessories after other finishing operations, including painting, have been completed.
- B. Do not install flooring products over cementitious underlayment until the slabs have cured and are sufficiently dry to bond with adhesive as determined by flooring manufacturer's recommended bond and moisture test.

1.11 WARRANTY

- A. Flooring products shall be warranted within the specified term and conditions after the

date of substantial completion:

1. Warranty Period commencing on the Date of Substantial Completion:
 - a. Luxury Vinyl Tile: 10-year warranty.
 - b. Heterogenous Sheet Vinyl: 5-year warranty. Rubber Sheet: 5-year warranty.
 - c. Rubber Tile: 1 year warranty.
 - d. Rubber Base: 1-year manufacturing and workmanship warranty.

1.12 PRE-INSTALLATION MEETINGS

- A. Conduct a pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions and manufacturer's warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the products identified in the "List of Finishes" on the Drawings and specified in each Product Data Sheet at end of this Section.

2.02 RESILIENT TILE

- A. Luxury Vinyl Tile: Products complying with ASTM F1700, Class 3 (Printed Film), Type B - Embossed, and with the requirements in Luxury Vinyl Tile Product Data Sheet at the end of the section.
- B. Rubber Tile: Products complying with ASTM F1344 and with the requirements in Rubber Tile Product Data Sheet at the end of the section.

2.03 RESILIENT SHEET

- A. Heterogenous Sheet Vinyl Products complying with ASTM F1303 and with requirements in Heterogenous Sheet Vinyl Flooring Data Sheet at the end of this section.
- B. Rubber Sheet: Products complying with ASTM F1859 and with the requirements in the Sheet Rubber Product Data Sheet at the end of this section.

2.04 RESILIENT WALL BASE

- A. Rubber Wall Base Thermoset Vulcanized Rubber (Type TS): Products complying with F1861, Group 1, and requirements specified in the Rubber Wall Base Product Data Sheet at end of this Section.

2.05 RESILIENT ACCESSORIES

- A. Provide tapered vinyl moldings to match rubber base as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on molding of a maximum of 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.06 INSTALLATION ACCESSORIES

- A. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.
- B. Trowelable Underlayments and Patching Compounds: Latex-modified, Portland cement-based formulation provided or approved by flooring manufacturer for applications indicated.
- C. Adhesives: Water-resistant type recommended by flooring manufacturer to maintain flooring warranty.
- D. Sheet Flooring Heat Weld Compound: As recommended by sheet flooring manufacturer.
- E. Capping Strip: As recommended by sheet flooring manufacturer.
- F. Filler for Coved Base: As recommended by sheet flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify concrete floors are dry to a maximum moisture content allowed by flooring manufacturer, and exhibit negative alkalinity, carbonization, or dusting.
- B. Perform all of the following tests, bond and moisture test and relative humidity test on all floors scheduled to receive resilient flooring. Refer to Section 01 45 23 for testing requirements. If any one of the tests specified fails, the concrete is not sufficiently dry for the installation of the resilient flooring products scheduled. The general contractor shall immediately notify the architect of the results of the tests.

1. Bond and Moisture Test: Use this test to determine if the concrete is sufficiently dry as well as to determine the compatibility of resilient flooring adhesives to concrete subfloors after removal of old adhesives, curing agents, breaker compounds, dust inhibitors, oil, grease, paint, varnish and other special surface treatments or conditions. Using the flooring material and recommended adhesives, install 3 feet by 3 feet panels spaced approximately 50 feet apart throughout the subfloor area. Select areas next to walls, columns or other light traffic areas. Tape edges of panels to prevent edge drying of adhesive.

If the panels are securely bonded after a period of 72 hours, you may conclude that the subfloor surface is dry and sufficiently clean of foreign material for satisfactory installation of the resilient flooring. Material can be considered "securely bonded" if an unusual amount of force is required to lift it from the subfloor.

2. Relative Humidity Test Methods: Perform humidity testing using in situ probes in accordance with ASTM F2170.

Before performing the tests, the buildings permanent HVAC system shall have been running for a minimum of 90 days.

- a. **For the first 1,000 square feet perform three tests.**
- b. **For each additional 1,000 square feet perform 1 test per 1,000**

square feet.

3. The surface of the concrete must have a pH of 9 or less.
- C. Relative Humidity Levels: In accordance with manufacturer's requirements.
- D. Verify floor and lower wall surfaces are free of substances that may impair adhesion of new adhesive and finish materials.
 1. Concrete floors with curing, hardening and breaking compounds shall be abraded with mechanical methods only to remove compounds. Use Blastrac or similar equipment.
- E. Comply with ASTM F710 and manufacturer's recommendations for surface preparation.
 1. Concrete floors with steel troweled (slick) finish shall be properly roughened up (sanded) to ensure suitable adhesion.

3.02 PREPARATION

- A. Acclimate the flooring in a secure storage area per the manufacturer's recommendations.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes and other defects with subfloor filler to achieve smooth, flat, hard surface.
 1. Do not proceed with the Work until the surface has been properly prepared. Flooring installer shall immediately notify the Contractor of any deficiencies in the floor substrate.
- C. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.
- E. Apply primer to surfaces, where required by flooring manufacturer.

3.03 GENERAL INSTALLATION – RESILIENT FLOORING

- A. Comply with floor covering manufacturer's installation directions and other requirements indicated that are applicable to each type of floor covering installation included in Project.
- B. Where demountable partitions and other items are indicated for installing on top of finished resilient floor, install flooring before these items are installed.
- C. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- D. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.
- E. Install edge strips at unprotected or exposed edges, where flooring terminates and where indicated. Secure resilient strips by adhesive.
- F. Extend resilient flooring into toe spaces, door reveals, closets and similar openings

without interrupting floor pattern.

- G. At movable partitions, install flooring under partitions without interrupting floor pattern.
- H. Maintain reference markers, holes, or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent marking device.
- I. Install resilient flooring on covers for telephone and electrical ducts and similar items occurring within finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring installed on these covers. Tightly adhere edges to perimeter of floor around covers and to covers.
- J. Install feature strips and floor markings where indicated. Fit joints tightly.
- K. Adhere resilient floor covering to flooring substrates without producing open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks or other surface imperfections in completed tile installation.
- L. Use full spread of adhesive applied to substrate in compliance with flooring manufacturer's directions including those for trowel notching, adhesive mixing and adhesive open and working times.

3.04 INSTALLATION – TILE FLOORING

- A. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths at perimeter that equal less than one-half of a tile. Install tiles square with room axis, unless otherwise indicated.
- B. Match tiles for color and pattern by selecting tiles from cartons in sequence as the manufacturer recommends. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in pattern with respect to location of colors, patterns, and sizes as indicated on Drawings.
 - 2. If pattern is not identified on Drawings, lay tiles per manufacturers recommendations.
- C. Luxury Vinyl Tile to be rolled with a 100-pound roller in both directions immediately after installation.

3.05 INSTALLATION – SHEET FLOORING

- A. Roll out resilient sheet flooring material with top surface up. Trim off all damaged edges. Allow material to relax for duration as recommended by manufacturer.
- B. Refer to manufacturer's recommendations for method of seam cutting and sealing.
- C. Heterogenous sheet vinyl flooring to be rolled with a 100-pound roller in both directions immediately after installation.

- D. Provide integral cove wall base where shown on the Drawings, include cove fillet support strip and top edge cap trim. Construct flash cove base in accordance with the flooring manufacturer's instructions. Weld seams per manufacturer's instructions.

3.06 INSTALLATION – BASE AND ACCESSORIES

- A. General: Install products specified in this section using methods indicated according to manufacturer's installation directions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and other permanent fixtures in rooms and areas where base is required. Install wall base in lengths as long as practicable. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
 - 1. On irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
 - 2. Install inside and exterior corners before installing straight pieces.
 - 3. Form inside corners on job from straight pieces of maximum lengths possible by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce snug fit to substrate.
 - 4. Form outside corners on job from straight pieces of maximum lengths possible by shaving back of base at point where bending will occur. Remove a strip perpendicular to length of base and only deep enough to produce a snug fit without bends whitening or removal of more than half the thickness of wall base.
- C. Place resilient accessories so they are butted to adjacent materials of type indicated and bond to substrates with adhesive. Install reducer strips at edges of flooring that otherwise would be exposed.

3.07 CLEANING

- A. Clean work under provisions of Section 01 70 00 – Execution and Closeout Requirements.
- B. Remove excess adhesive from floor, base and wall surfaces without damage.
- C. Clean all resilient products specified, in accordance with manufacturer's written instructions.
 - 1. Products that require a polish or wax should be done so according to the manufacturer's recommendations unless noted otherwise.
- D. The contractor shall provide its own equipment for floor care and take all precautions to secure area for safety and use appropriate signage such as "WET FLOOR" signs. Signs shall be in English and Spanish.

3.08 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 70 00 – Execution and Closeout

Requirements.

- B. Prohibit traffic on floor finish and stair treads for a duration as recommended by the manufacturer.
- C. Protect the flooring using plywood, Masonite or a similar product for the duration of the project as recommended by the flooring manufacturer.

3.09 PRODUCT DATA SHEET 1 – LUXURY VINYL FLOOR TILE

- A. Basis of Design: Refer to “List of Finishes” on the drawings.
- B. Vinyl Floor Tile Designation: LVT.
- C. Reference Specifications: ASTM F1700, Class 3, Type B – Embossed.
- D. Adhesive: Recommended by flooring manufacturer for substrate indicated and to maintain warranty.
- E. Colors and Patterns: As scheduled on the Drawings.

3.10 PRODUCT DATA SHEET 2 – RUBBER FLOOR TILE

- A. Basis of Design: Refer to “List of Finishes” on the drawings.
- B. Rubber Floor Tile Designation: RT.
- C. Reference Specifications: ASTM F1344.
- D. Adhesive: Recommended by flooring manufacturer for substrate indicated and to maintain warranty.
- E. Seams: Heat weld.
- F. Colors and Patterns: As scheduled on the Drawings.

3.11 PRODUCT DATA SHEET 3– RUBBER SHEET FLOORING

- A. Basis of Design: Refer to “List of Finishes” on the drawings.
- B. Rubber Sheet Flooring Designation: RS.
- C. Reference Specifications: ASTM F1859.
- D. Adhesive: Recommended by flooring manufacturer for substrate indicated and to maintain warranty.
- E. Seams: Heat weld.
- F. Colors and Patterns: As scheduled on the Drawings.

3.12 PRODUCT DATA SHEET 4 – HETEROGENEOUS SHEET FLOORING

- A. Basis of Design: Refer to "List of Finishes" on the drawings.
- B. Linoleum Floor Tile Designation: RS.
- C. Reference Specifications: ASTM F1303.
- D. Adhesive: Recommended by flooring manufacturer for substrate indicated and to maintain warranty.
- E. Seams: Heat weld.
- F. Colors and Patterns: As scheduled on the Drawings.

3.13 PRODUCT DATA SHEET 5 – RUBBER WALL BASE

- A. Basis of Design: Refer to "List of Finishes" on the drawings.
- B. Rubber Wall Base Designation: RB.
- C. Reference Specifications: ASTM F1861, Group 1 (solid), Style B (coved).
- D. Form: 4 inches high, rolls.
- E. Style: Cove with top-set toe.
- F. Adhesive: As recommended by manufacturer.
- G. Exterior Corners: Job formed only.
- H. Interior Corners: Job formed only.
- I. Colors and Pattern: As scheduled on the Drawings.

END OF SECTION

SECTION 09 68 13 – TILE CARPETING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes carpet tile and accessories.
- B. Related Sections:
 - 1. Section 01 45 23 – Concrete In-Situ Relative Humidity and pH Testing.
 - 2. Section 09 65 00 – Resilient Flooring.

1.02 REFERENCES

- A. Carpet and Rug Institute:
 - 1. CRI Carpet Installation Standard – Standard for Installation of Commercial Carpet.
 - 2. CRI Green Label Plus Testing Program.
 - 3. CRI Model Specifications for Commercial Carpets.
- B. Consumer Products Safety Commission:
 - 1. CPSC 16 CFR 1630 – Standard for the Surface Flammability of Carpets and Rugs.
- C. National Fire Protection Association:
 - 1. NFPA 253 – Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

1.03 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Samples:
 - 1. Submit four carpet tiles illustrating color and pattern design for each carpet color selected.
 - 2. Exposed edge, transition and other accessory stripping: 12-inch-long samples.
- D. Manufacturer's Installation Instructions: Submit special procedures, perimeter conditions requiring special attention, and maintenance instructions.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.05 QUALITY ASSURANCE

- A. Surface Burning Characteristics:
 - 1. Floor Finishes: Comply with the following:
 - a. At corridors and rooms or spaces not separated from corridors by partitions extending from floor to underside of ceiling provide carpet tile complying with Class II, minimum 0.22 watts/sq cm when tested in accordance with NFPA 253.
 - b. In all occupancies, provide carpet tile which complies with DOC FF-1 "Pill Test" CPSC 16 CFR Part 1630 or with ASTM D 2859.
- B. Texture Appearance Retention Rating: Rating classifications as determined by CRI Model Specifications for Commercial Carpets.
 - 1. Carpet Tiles to be greater than or equal to 3.0 TARR for Heavy Traffic Level Classification.

1.06 QUALIFICATIONS

- A. Installer: Company specializing in performing work of this section with minimum five years of experience approved by manufacturer.
 - 1. Floor Covering Installation Contractors Association (FCICA) or International Certified Floorcovering Installers Association (ICFI) certified carpet installers.

1.07 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements.
- B. Store materials in area of installation for 48 hours prior to installation.
- C. Maintain minimum 70 degrees F ambient temperature 3 days prior to, during and 24 hours after installation.
- D. Ventilate installation area during installation and for 3 days after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the products identified in the "List of Finishes" on the Drawings.

2.02 CARPET TILE

- A. Carpet Tile: Products meeting the testing and product requirements of the Carpet and Rug Institute Green Label Plus Program.

2.03 COMPONENTS

- A. Carpet Tiles CPT: Refer to "List of Finishes" on drawings.

2.04 ACCESSORIES

- A. Subfloor Filler: Cementitious Type recommended by flooring material manufacturer.\
- B. Moldings and Edge Strips: Vinyl; color as selected.
- C. Adhesives: As recommended by the manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify floor surfaces are smooth and flat within tolerances specified in Section 03 30 00 – Cast-in-Place Concrete and are ready to receive work.
- C. Verify concrete floors are ready for carpet installation by testing for relative humidity and alkalinity. Obtain instructions when test results are not within specified limits.
 - 1. Relative humidity: In accordance with manufacturer's requirements.
 - 2. Alkalinity: pH range of 5-9.

3.02 PREPARATION

- A. It shall be the responsibility of the General Contractor to present the floors in a condition to receive the carpet.
- B. Surface to receive carpet tiles must be free of dirt, solvents, oil, grease, paint, plaster, moisture and other substances detrimental to proper performance of adhesive and carpet.
- C. Concrete Surfaces

1. The General Contractor must submit to the floor covering installation contractor prior to installation a written report on the moisture and alkalinity condition of the concrete slab.
2. Check to ensure there is no dusting. A primer may be needed to prevent dusting.

3.03 INSTALLATION

- A. Install Carpet tile in accordance with manufacturer's written instructions and with CRI Carpet Installation Standard to maintain uniformity of direction and lay of pile.
- B. Do not mix carpet from different cartons unless from same dye lot or otherwise noted.
- C. Butt carpet tile edges firmly together to form seams without gaps. Remove adhesive promptly from face of carpet.
- D. Where carpet meets dissimilar floor surface, proper edge molding shall be used.
- E. Install edge moldings where carpet edge is exposed and at transitions to other floor coverings. Edge moldings shall be securely anchored to substrate.

3.04 CLEANING

- A. Section 01 70 00 – Execution and Closeout Requirements: Final cleaning.
- B. Remove excess adhesive from floor, base and wall surfaces without damage.
- C. Clean and vacuum carpet surfaces.

3.05 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 – Execution and Closeout Requirements: Protecting installed construction.
- B. Do not permit traffic over unprotected floor surface.
 1. Cover carpeting in traffic areas with protective non-staining building paper. Do not use plastic sheeting.

END OF SECTION

SECTION 09 72 10 - WALLCOVERINGS

PART 1 GENERAL

1.01 SUMMARY

A. Division Includes:

1. Wallcoverings

B. Related Sections:

1. Section 09 21 16 - Gypsum Board Assemblies: Level 4 finish.
2. Section 09 90 00 - Painting and Coating: Primer

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. E84 - Test Method for Surface Burning Characteristics of Building Materials.
2. F793 – Standard Classification of Wallcovering by Use Characteristics

B. Gypsum Association

1. GA-214 - Recommended Levels of Finish for Gypsum Board, Glass Mat & Fiber Reinforced Gypsum Panels.

1.03 SUBMITTALS

A. For each type of wallcovering material specified, the contractor shall submit:

1. For architect's approval: One 7" x 7" sample, labeled with the appropriate material name and SKU information.
2. For Owner's approval: A copy of the maintenance instructions, as provided by the manufacturer.

1.04 QUALITY ASSURANCE

A. Installer: Installation by skilled commercial wallcovering contractor with no less than three years of documented experience installing wallcovering of the types and extent required.

B. Surface Burning Characteristics Classification: Provide materials that meet Class I/A rating when tested in accordance with ASTM E84 for flame spread and smoke developed.

C. Field Samples: Prepare field samples for architect's review and establish requirements for seaming and finish trim.

1. Install sample panel of each type wallcovering specified in area designated by architect.

2. Maintain corrected and approved samples to serve as a standard of performance for the project.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall coverings to the project site in unbroken and undamaged original factory packaging and clearly labeled with the manufacturer's identification label, quality or grade, and lot number.
- B. Store materials in a clean, dry storage area with temperature maintained above 55-degrees Fahrenheit with normal humidity.
- C. Inspect wall covering to verify that the delivered product is correct and that the color is accurate to what was ordered.
- D. Store material within original packaging to prevent damage.

1.06 PROJECT CONDITIONS

- A. Do not apply wallcoverings when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.
- B. Provide continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures between 65-85° Fahrenheit.
- C. Apply adhesive when substrate surface temperature and ambient temperature is above 55° Fahrenheit and relative humidity is below forty percent.
- D. Maintain constant recommended temperature and humidity for at least seventy-two hours prior to and throughout the installation period, and for seventy-two hours after wallcovering installation completion.
- E. Provide not less than 80-foot-candles per square foot lighting level measured mid-height at substrate surfaces.
- F. Gypsum board finish shall be completed to comply with AWCI specification, Level 4 or higher.

1.07 WARRANTY

- A. Submit manufacturer's written warranty against manufacturing defects.

1.08 MAINTENANCE

- A. Maintenance instructions: Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

PART 2 PRODUCTS

2.01 MANUFACTURER AND PRODUCT

- A. Refer to "List of Finishes" on drawings.

2.02 ACCESSORIES

- A. Adhesives: Heavy-duty clear or clay based premixed vinyl adhesive.
- B. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.
 - 1. Refer to Section 09 90 00 – Painting and Coating for primer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 4 finish, per GA-214: Recommended Levels of Gypsum Board of Finish for Gypsum Board, Glass Mat & Fiber Reinforced Gypsum Panels and permanent lighting should be installed and operational.
- B. Test substrate with a suitable moisture meter and verify that moisture content does not exceed four percent.
- C. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface. The moisture content of the wall shall be checked with a moisture meter and not be over 7 percent.
- D. Evaluate all painted surfaces for the possibility of pigment bleed-through.
- E. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.
- F. Examine the product and verify that the color, scale and design are what was specified, the product is free from defects and the alignment of the pattern across panels is correct.

3.02 INSTALLATION

- A. Acclimate wallcovering in the area of installation a minimum of twenty-four hours before installation.
- B. Read and follow the manufacturer's installation instruction sheet contained in each roll of wallcovering. This is a custom product and therefore the installation requires a higher attention to detail than installation of standard wallcovering.
- C. Adhesive: Apply a uniform coat of adhesive as recommended by the manufacturer.
- D. Primer: Use a quality pigmented acrylic wallcovering primer if needed and recommended by manufacturer.
- E. Install wall covering in accordance with the Installation Diagram included with the finished goods. Double- Cut seams to provide pattern match.
- F. Apply wallcovering to the substrate using a wallcovering smoother, wrapped with a soft cloth, to remove air bubbles. Do not use sharp edged smoothing tools. Smooth material on the wall from the middle to the outside edge.

- G. Remove excess adhesive immediately after the wallcovering is applied. Clean as recommended by manufacturer.
- H. Stop installation of material that is questionable in appearance and notify the manufacturer's representative for an inspection.

3.03 CLEAN-UP

- A. Upon completion of installation, remove all exposed adhesive immediately using a soft cloth and a warm, mild soap solution and rinse thoroughly with water and dry with clean towel prior to using.
- B. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the wallcovering installation. Leave areas in neat, clean, and orderly condition. Contractor shall protect finished wallcovering from damage.

END OF SECTION

SECTION 09 90 00 – PAINTING AND COATING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This Section includes surface preparation, painting and finishing of exposed interior and exterior items and surfaces.
 - 1. Surface preparation, priming and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.
- B. Paint exposed surfaces whether or not colors are designated in “schedules,” except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available. Sherwin Williams Coatings listed at the end of this specification where used to establish the level of quality of the coating systems. The coating manufacturer shall match the colors identified in the finish schedule.
 - 1. Painting includes field painting exposed bare pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- C. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
 - 1. Pre-finished items not to be painted include the following factory-finished components:
 - a. Acoustic materials.
 - b. Finished mechanical and electrical equipment.
 - c. Light fixtures.
 - d. Switchgear.
 - e. Distribution cabinets.
 - f. Plastic laminate wood doors.
 - g. Metal lockers.
 - h. Plastic laminate covered architectural casework.
 - i. Metal flashings.
 - j. Storefront system.
 - 2. Concealed surfaces not to be painted include wall or ceiling surfaces in the following generally inaccessible areas:
 - a. Furred areas.
 - b. Pipe spaces.
 - c. Ceiling plenums.
 - 3. Finished metal surfaces not to be painted include:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.

- d. Copper.
 - e. Bronze or brass.
4. Operating parts not to be painted include moving parts of operating equipment such as the following:
- a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.02 RELATED SECTIONS

- A. Section 05 12 00 – Structural Steel Framing: Shop Primed Items.
- B. Section 05 21 00 – Steel Joist Framing: Shop Primed Items.
- C. Section 05 50 00 – Metal Fabrications: Shop Primed Items.
- D. Section 08 12 14 – Standard Steel Frames: Shop Primed, Field Painted.
- E. Section 08 13 14 – Standard Steel Doors: Shop Primed, Field Painted.
- F. Section 09 21 16 – Gypsum Board Assemblies: Finishing gypsum board prior to application of paint.
- G. Section 09 72 10 - Wall Covering: Preparation and priming of substrate scheduled to receive wall covering.
- H. Section 22 05 53 – Identification for Plumbing Piping and Equipment.
- I. Section 23 05 53 – Identification for HVAC Piping and Equipment.
- J. Section 26 05 53 – Identification for Electrical Systems.
- K. Section 27 05 53 – Identification for Communication Systems.

1.03 REFERENCES

- A. Steel Structures Painting Council
 - 1. SP-1 Solvent Cleaning
 - 2. SP-2 Hand Tool Cleaning
 - 3. SP-3 Power Tool Cleaning
 - 4. SP-13 Nace No. 6 Surface Preparation for Concrete

B. ASTM

1. ASTM D 3359 – Standard Test Methods for Rating Adhesion by Tape Test.

1.04 SUBMITTALS

A. Submit in accordance with Section 01 33 00 – Submittal Procedures.

B. Product Data: Manufacturer's data sheets on each paint and coating product shall include:

1. Product characteristics.
2. Surface preparation instructions and recommendations.
3. Primer requirements and finish specification.
4. Storage and handling requirements and recommendations.
5. Application methods.

C. Samples: Upon selection of colors by the Architect, submit samples for Architect's review of color and texture only. Provide a listing of material and application for each coat of each finish sample.

1. On 12 inch by 12 inch hardboard, provide one sample of each paint color listed in the color schedule, with texture to simulate actual conditions. Resubmit samples as requested by Architect until acceptable sheen, color and texture are achieved. Samples shall be stepped to show primer, first coat and second coat.
2. On actual wall surfaces, duplicate painted finishes of prepared samples as directed by Architect. On at least 100 square feet of surface as directed, provide full-coat finish samples until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work.
3. Do not proceed with painting until materials and finishes are approved by Architect.

1.05 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same manufacturer as the finish coats.

B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect of problems anticipated using the materials specified.

C. Material Quality: Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary names used to designate colors or materials are not intended to imply that products named are required or to exclude equal products of other manufacturers.
 2. Federal Specifications establish a minimum quality level for paint materials, except where other product identification is used. Provide written certification from the manufacturer that materials provided meet or exceed these criteria.
 3. Products that comply with qualitative requirements of applicable Federal Specifications, yet differ in quantitative requirements, may be considered for use when acceptable to the Architect. Furnish material data and manufacturer's certificate of performance to Architect for proposed substitutions.
- D. Chemical Component Restrictions: The manufacturer shall demonstrate that the following chemical compounds are not used as ingredients in the manufacture of the product:
1. Halomethanes:
 - a. Methylene chloride
 2. Chlorinated ethanes:
 - a. 1,1,1-trichloroethane
 3. Aromatic solvents:
 - a. Benzene
 - b. Toluene (methylbenzene)
 - c. Ethylbenzene
 4. Chlorinated ethylenes:
 - a. Vinyl chloride
 5. Polynuclear aromatics:
 - a. Naphthalene
 6. Chlorobenzenes:
 - a. 1,2-dichlorobenzene
 7. Phthalate esters:
 - a. Di (2-ethylhexyl) phthalate
 - b. Butyl benzyl phthalate
 - c. Di-n-butyl phthalate
 - d. Di-n-octyl phthalate
 - e. Diethyl phthalate
 - f. Dimethyl phthalate
 8. Miscellaneous semi-volatile organics:

- a. Isophorone
- 9. Metals and their compounds:
 - a. Antimony
 - b. Cadmium
 - c. Hexavalent chromium
 - d. Lead
 - e. Mercury
- 10. Preservatives (anti-fouling agents)
 - a. Formaldehyde
- 11. Ketones:
 - a. Methyl ethyl ketone
 - b. Methyl isobutyl ketone
- 12. Miscellaneous volatile organics:
 - a. Acrolein
 - b. Acrylonitrile
- E. Packaging Requirements:
 - 1. Toxics in packaging:
 - a. The manufacturer shall demonstrate that paint cans and their components are not fabricated with lead.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Product name or title of material.
 - 2. Product description (generic classification or binder type).
 - 3. Federal Specification number, if applicable.
 - 4. Manufacturer's stock number and date of manufacture.
 - 5. Contents by volume, for pigment and vehicle constituents.
 - 6. VOC content.
 - 7. Thinning instructions.
 - 8. Application instructions.
 - 9. Color name and number.

- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 degrees F (7 degrees C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.
- C. Provide coating systems which are VOC compliant as specified.

1.07 JOB CONDITIONS

- A. Section 01 60 00 – Product Requirements.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint manufacturer.
- C. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 degrees F (10 degrees C) and 90 degrees F (32 degrees C).
- D. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 degrees F (7 degrees C) and 95 degrees F (35 degrees C).
- E. Do not apply paint in snow, rain, fog or mist, when the relative humidity exceeds 85 percent, at temperatures less than 5 degrees F (3 degrees C) above the dew point, or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.
- F. Provide lighting level of 80-foot candle measured mid-height at substrate surface.

1.08 PRE-PAINTING CONFERENCE

- A. Prior to finish painting, exterior and interior, General Contractor shall schedule a "Pre-Painting Conference" to be attended by the Architect, Contractor, painting subcontractor and Manufacturer's Representative. (Manufacturer's Rep. to attend when required for special finishes.)
- B. Agenda to include submittal of color and finishes sample (RE: Article 1.04 "Submittals" for review of color samples.
- C. Contractor to record discussions of conference including agreements and/or disagreements and distribute a copy of record to each party in attendance.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a standard of quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and does not change concept as expressed in Contract Documents as judged by Architect.
 - 1. Basis of Design Product Selections: Sherwin-Williams.
- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named alphabetically below. If not named, submit as substitution according to Conditions of the Contract and appropriate Division 1 sections.
 - 1. Benjamin Moore and Co.
 - 2. Pratt & Lambert
- C. Concrete Curing and Sealing Compound:
 - 1. W.R. Meadows Co. or approved equivalent.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.
 - 1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.02 PREPARATION

- A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.
 - 1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime. Notify Architect in writing of problems anticipated with using the specified finish-coat material with substrates primed by others.

2. Ferrous Metals: Clean non-galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.
 - a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer and touch up with the same primer as the shop coat.
 3. Galvanized Surfaces: Allow to weather a minimum of 6 months prior to coating. Clean per SSPC-SP1 using detergent and water or a degreasing cleaner, then prime as required. When weathering is not possible or the surface has been treated with chromates or silicates, first Solvent Clean per SSPC-SP1 and apply a test area, priming as required. Allow the coating to dry at least one week before testing. If adhesion is poor, Brush Blast per SSPC-SP7 as necessary to remove these treatments.
 4. Cementitious Materials: Prepare concrete masonry block to be painted. Remove loose cement, efflorescence, chalk, dust, dirt, grease, and oils.
 - a. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
 - 1) Mortars shall be cured for a minimum of 30 days at 75 degrees F unless the manufacturer's products are designed for application prior to 30-day period.
 - 2) The surface of the mortar shall have a pH of between 6 and 9 and a moisture content of 15 percent or lower.
 - 3) Concrete block surfaces shall be dry before priming.
 - b. Damaged areas shall be repaired using appropriate materials.
 - 1) Fill bug holes, air pockets and other voids with a cement patching compound.
 5. Drywall: Surface must be clean and dry. All nail or screw heads must be set and spackled. Joints must be taped and covered with joint compound. Spackled fastener heads and tape joints must be sanded smooth and all dust removed prior to painting.
- C. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.
1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and if necessary, strain material before using.
 3. Use only thinners approved by the paint manufacturer, and only within recommended limits.

3.03 APPLICATION

- A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
 - 1. Non-zinc coated architectural metals, steel doors and steel frames shall have all coatings spray applied. Brush application is not acceptable.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, form release agents, sealers or conditions detrimental to formation of a durable paint film.
 - 1. Paint colors, surface treatments, and finishes are indicated in "schedules."
 - 2. Provide finish coats that are compatible with primers used.
 - 3. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.
 - 4. Apply additional coats when undercoats, stains or other conditions show through final coat of paint until paint film is of uniform finish, color and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
 - 5. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.
 - 6. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.
 - 7. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.
 - 8. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 - 9. Finish exterior doors on tops, bottoms, side edges and interior surfaces same as exterior faces.
 - 10. Apply a primer as scheduled over all surfaces that are shop primed from the manufacturer/fabricator that are scheduled to be painted.
- C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pre-treated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. Allow sufficient time between successive coats to permit proper drying. Do not

recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

- D. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.
- E. Mechanical and Electrical work: Painting mechanical and electrical work is limited to items exposed in mechanical equipment rooms and in occupied spaces.
- F. Prime Coats: Before application of finish coats, apply a prime coat of material as scheduled to material that is required to be painted or finished. Reprime surfaces that are factory primed. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears to assure a finish coat with no burn through or other defects due to insufficient sealing.
- G. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.
- H. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.
- I. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

3.04 CLEANING

- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish and other discarded paint materials from the site.
- B. Upon completion of painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping, using care not to scratch or damage adjacent finished surfaces.

3.05 PROTECTION

- A. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing and repainting, as acceptable to Architect.
- B. Provide "wet paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.
 - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.06 EXTERIOR PAINT SCHEDULE

- A. General: Provide the following paint systems for the various substrates, as indicated:

B. Metals

1. Ferrous Metal and Zinc Coated Metal:

- a. High Gloss Waterbased Acrylic Urethane Enamel: 2 finish coats over primer on properly prepared surface.
- b. Primer (factory primed and bare/unpainted steel surface):
 - 1) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer (B66-W00310 Series) (5.0-10.0 mils wet, 1.9-3.8 mils dry).
 - 2) VOC: Less than 96 g/L.
- c. First and Second Coats:
 - 1) Sherwin-Williams Waterbased Acrolon 100 Waterbased Urethane High Gloss (B65-700 Series) (4.0 – 8.0 mils wet, 1.8 – 3.6 mils dry per coat) spray applied.
 - 2) VOC: Less than 98 g/L

C. Concrete Block:

- 1. Two coats over primer on properly prepared surfaces.
- 2. Primer: Sherwin-Williams Pro Industrial Heavy-Duty Block Filler (B42W00150). (16.0-21.0 mils wet, 8.0-10.5 mils dry)
 - a. VOC: Less than 50 g/L
- 3. First and Second Coats: Sherwin-Williams ConFlex XL Smooth High-Build Acrylic Coating (CF11W0050 Series) (13.0-16.0 mils wet, 6.0-7.5 mils dry per coat). A total dry film thickness of 12-15 mils and a surface with 10 pinholes or less shall be provided for a waterproofing system.
 - a. VOC: Less than 50 g/L.

3.07 INTERIOR PAINT SCHEDULE

A. General: Provide the following paint systems for the various substrates as indicated.

B. Metals (Structural steel columns, joists, trusses, beams, doors, door frames)

1. Ferrous Metals and Zinc-Coated Metals:

- a. Semi-Gloss Latex: 2 finish coats over primer on properly prepared surface.
- b. Primer:
 - 1) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer (B66W00310 Series) (5.0-10.0 mils wet, 1.9-3.8 mils dry).
 - 2) VOC: 96 g/L.
- c. First and Second Coats:
 - 1) Sherwin-Williams Pro Industrial Acrylic Semi-Gloss (B66-650

- Series) (6.0-12.0 mils wet, 2.1-4.2 mils dry per coat).
2) VOC: Less than 50 g/L.
- C. Exposed Concrete Floors (Sealed)
1. Concrete densifier and chemical hardener.
 2. First Coat:
 - a. W.R. Meadows LIQUI-HARD.
 - 1) VOC concrete-curing compounds: 0 g/L.
- D. Special Coatings
1. Gypsum Drywall Walls and Ceilings Microbicidal Coating: Coating shall comply with EPA Reg. No. 64695-1. Furnish sample on 2 foot by 2 foot piece of drywall for Architect to approve prior to application.
 - a. Satin latex enamel: 2 finish coats over primer on properly prepared surface.
 - b. Texture: Orange Peel, USG Sheetrock Brand Wall and Ceiling Spray.
 - c. Primer:
 - 1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer (B28W02600 Series) (4.0 mils wet, 1.0 mils dry).
 - 2) VOC: 0 g/L.
 - d. Satin First and Second Coats:
 - 1) Sherwin-Williams SuperPaint Interior Latex Satin with Sanitizing Technology (A87W0001) (4.0 mils wet, 1.7 mils dry per coat).
 - 2) VOC: Less than 50 g/L.

END OF SECTION

SECTION 10 14 00 – SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior room plaques.

1.02 SUBMITTALS

- A. Manufacturer's Data: Submit manufacturer's descriptive literature and specifications, including color samples of material for selection, as applicable for approval.
- B. Submit Shop Drawings listing sign styles, lettering and locations, and overall dimensions of each sign.
- C. Submit full size sample sign of type, style and color specified including method of attachment.
- D. Sign manufacturer shall provide written certification that all interior signs comply with the 2010 Americans with Disabilities Act.

1.03 QUALITY ASSURANCE

- A. Interior signs shall comply with the requirements of the Americans with Disabilities Act-2010 ADA Standards for Accessible Design.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Package signs, labeled in name groups.
- C. Store adhesive attachment tape at ambient room temperatures.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not install signs when ambient temperature is lower than recommended by manufacturer.
- C. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 INTERIOR ROOM PLAQUE SIGNAGE

- A. Sign material shall consist of melamine plastic (high-pressure decorative laminate), approximately 1/8 inch thick. Edges of signs shall not have sharp or abrasive edges.
- B. All signs shall be of one-piece construction. Added-on and/or engraved characters will

not be approved.

- C. All letters, numbers and/or symbols shall contrast with their background with either light characters on a dark background or dark characters on a light background. Braille may be either the same color as the background or the same color as the characters.
- D. Characters and background shall have a non-glare finish.
- E. All interior signs shall have the following characteristics:
 - 1. Characters and symbols: Raised 1/32 inch minimum above the sign background.
 - 2. Character style: Sans serif character.
 - a. Acceptable fonts include:
 - 1) Helvetica.
 - 2) Arial.
 - 3. Character case: Uppercase.
 - 4. Character height: Character height measured vertically from the baseline of the character shall be 5/8 inch minimum and 2 inches maximum based on the height of the uppercase letter "I."
 - 5. Character stroke thickness: Stroke thickness of the uppercase letter "I" shall be 15 percent maximum of the height of the character.
 - 6. Character spacing: Character spacing shall be 1/8 inch minimum and maximum 4 times the raised character stroke width.
 - a. Characters shall be separated from raised borders and decorative elements minimum 3/8 inch.
 - 7. Braille:
 - a. Braille shall be Grade 2. Sign manufacturer shall
 - b. Braille dots shall have a domed or rounded shape and shall comply with the Braille dimensions listed in the 2010 Standard.
 - 1) The indication of an uppercase letter or letters shall only be used before the first word of sentences, proper nouns and names, individual letters of the alphabet, initials and acronyms.
 - c. Braille shall duplicate the raised characters and shall be positioned below the corresponding text.
 - 1) If text is multi-lined, Braille shall be placed below the entire text.
 - 2) Braille shall be separated 3/8 inch minimum from tactile characters and 3/8 inch minimum from raised borders and decorative elements.

F. Pictograms:

1. Pictograms shall be provided on signs installed at the following spaces:
 - a. Restrooms, toilet rooms.
 - b. Locker rooms, dressing rooms.
2. Pictograms shall have a field height of minimum 6 inches. Note: Pictogram characters and Braille shall not be located in the pictogram field.
3. Pictograms shall contrast with their field with either a light pictogram on a dark field or a dark pictogram on a light field.
 - a. Pictograms and their field shall have a non-glare finish.
4. Pictograms shall have text descriptions located directly below the pictogram. Text descriptors shall comply with Paragraph E of this article.
5. Provide male pictograms at spaces used by men. Provide female pictograms at spaces used by women. At toilet rooms indicated to be used by both men and women, provide both male and female pictograms on the same sign.

G. International Symbol of Accessibility

1. The International Symbol of Accessibility shall be provided on signs installed at the following spaces:
 - a. Restrooms, toilet rooms.
 - b. Locker rooms, dressing rooms.
2. The International Symbol shall comply with the figure shown in the 2010 Standards.
3. The International Symbol of Accessibility shall contrast with the background per Paragraph F, Subparagraph 3 of this Article, including non-glare finish.

H. Corner Style: Square.

2.02 INTERIOR ROOM PLAQUE SIGN SIZE

- A. Provide size of sign as required to fit designated room names, room numbers, pictograms, International Symbol of Accessibility, and/or Braille.

2.03 SIGN SCHEDULE

- A. Provide one interior room plaque sign for each interior door.
- B. Means of egress signs:
 1. Provide tactile signs complying with TAS at the following locations:
 - a. Exit discharge.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine installation areas to ensure that proper condition exist for timely completion of installation.

3.02 PREPARATION

- A. Verify that mounting locations and height for each sign will comply with ADA Accessibility Guidelines.
- B. Mounting locations should be smooth and free of all dirt, dust, grease, etc.

3.03 INSTALLATION

- A. Mount signs level and plumb using manufacturer's recommended standard mounting hardware of vinyl foam tape or holes and screws.
- B. Remove excess adhesives, etc. from exposed sign surfaces as recommended by adhesive manufacturer. Clean sign surfaces as needed.
- C. Where signs are mounted to vision glass (sidelights, borrowed lights, etc.), provide a backing plate made of the same materials, size, thickness and background color as the sign. Mount backing plate on opposite side of glass using foam tape or adhesive. Backing plate shall be aligned with sign in order to hide the sign's mounting.

END OF SECTION

SECTION 10 21 15 – PLASTIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes solid plastic toilet compartments.
- B. Related Sections:
 - 1. Section 06 10 53 – Miscellaneous Carpentry: Concealed wood framing and blocking for compartment support.
 - 2. Section 10 28 00 – Toilet, Bath and Laundry Accessories.

1.02 REFERENCES

- A. ASTM A666 – Standard Specification for Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
- B. ASTM E84-Standard Test Methods for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association (NFPA) 286 – Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- D. Texas Accessibility Standards, 2012 Edition.

1.03 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.
- C. Product Data: Submit data on panel construction, hardware and accessories.
- D. Samples: Submit two 6 x 6 inch in size illustrating panel finish, color and sheen.
- E. Manufacturer's Installation Instructions: Submit special procedures, perimeter conditions requiring special attention, and maintenance instructions.

1.04 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with placement of support framing and anchors in wall.

1.05 QUALITY ASSURANCE

- A. Solid plastic products to be independently certified in writing by the manufacturer indicating compliance to appropriate building codes governing the project as it applies to the use of "plastic in a commercial building."

- B. Toilet partitions and urinal screens shall be installed only by manufacturer-approved installers.
- C. Fire Hazard Classification: Pass NFPA 286.

1.06 WARRANTY

- A. Manufacturer to supply a written warranty covering all plastic components and plastic hardware against breakage, corrosion and delamination for a period of 15 years.

PART 2 PRODUCTS

2.01 SOLID PLASTIC TOILET COMPARTMENTS

- A. Manufacturers:
 - 1. Accurate Partitions Corp., Floor-Mounted, Overhead-Braced.
 - 2. Comtec Industries Model Floor-Mounted, Overhead-Braced Standard Series S200.
 - 3. Scranton Products, Model Floor-Mounted, Overhead-Braced.
 - 4. Substitutions: Refer to Section 01 60 00 – Product Requirements.
- B. Product Description: Floor-mounted, overhead-braced toilet compartments.
- C. Panels, doors and pilasters shall be fabricated from high-density polyethylene (HDPE) containing a minimum of 10% recycled material manufactured under high pressure, forming a single component section which is waterproof, non-absorbent and has a self-lubricating surface that resists marking with pens, pencils or other writing utensils. All panels, doors and pilasters to arrive at job-site with special protective plastic covering.

2.02 COMPONENTS

- A. Toilet Compartments: Solid molded plastic panels, doors and pilasters, floor-mounted and headrail-braced.
 - 1. Color: Single color as selected.
- B. Door and Panel Dimensions:
 - 1. Thickness: 1 inch
 - 2. Door Width: 24 inch minimum.
 - 3. Accessible Door Width: 32-inch clear opening with the door open 90 degrees, measured between the face of the door and the opposite stop, out-swinging or in-swinging as shown on Drawings.
 - 4. Height: 55 inches.
 - 5. Thickness of Pilasters: 1 inch.

- C. Toe clearance: Provide a minimum of 12 inches between the finish floor and the bottom of the toilet partitions.

2.03 CHARACTERISTICS

- A. Doors, panels and pilasters shall have all edges machined to a radius of .250 inch and all exposed surfaces to be free of saw marks.
- B. Aluminum edging strips to be fastened to the bottom edge of all doors and panels using vandal-proof stainless-steel fasteners.

2.04 HARDWARE

- A. Hinges:
 - 1. 8 inches long, fabricated from heavy-duty extruded aluminum with bright-dipped anodized finish, wrap-around flanges, adjustable on 30-degree increments, through bolted to doors and pilasters with stainless steel, Torx head sex bolts.
 - 2. Hinges operate on field-adjustable nylon cams, field adjustable in 30-degree increments and self closing.
 - 3. Each handicapped door to include: (2) door pulls and (1) wall stop. Door pull shall be placed on each side of the door near the latch.
 - 4. Door strike and keeper shall be fabricated from heavy aluminum extrusion (6463-T5 alloy) with bright-dipped anodized finish with wrap-around flange surface-mounted and thru-bolted to pilaster with star head security pin, stainless steel barrel bolts. Size of strike shall be 6 inches in length.
 - 5. Door latch housing shall be fabricated from heavy aluminum extrusion (6463-T5 alloy) with bright-dipped anodized finish, surface-mounted, and through-bolted to door with star-head security pin, stainless steel barrel bolts. Slide bolt and button shall be heavy aluminum with "Tuff-Coat Black" anodized finish.
- B. 20-gauge stainless steel pilaster shoes shall be anchored to finished floor with plastic anchors and #14 by 1-1/2 inches star-head security pin, stainless steel screws.
- C. Full-length continuous heavy-duty wall brackets. Brackets shall be used for all panels to pilaster, pilaster to wall, and panel to wall connections. Wall brackets shall be through-bolted to panels and pilaster with star-head security pin, stainless steel barrel bolts. Attachment of brackets to adjacent wall construction shall be accomplished by #14 by 1-1/2 inch star-head security pin, stainless steel screws anchored directly behind the vertical edge of panels and pilasters at 13-inch intervals along the full length of bracket and at each 13-inch interval alternately spaced between anchor connections.
- D. Headrail shall be heavy aluminum extrusion (6463-T5 alloy) with bright-dipped anodized finish in anti-grip configuration weighing not less than 1.188 lbs. per linear foot. Headrail shall be fastened to top of pilasters and headrail brackets by through-bolting with star-head security pin, stainless steel barrel bolts (no cadmium-plated bolts allowed).
- E. Headrail brackets shall be 18-gauge stainless steel.

- F. Provide coat hook with door bumper on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify field measurements are as indicated on Shop Drawings.
- C. Verify correct spacing of and between plumbing fixtures.
- D. Verify correct location of built-in framing, anchorage and bracing.

3.02 INSTALLATION

- A. Erection of partitions shall be in accordance with the manufacturer's recommendations.
- B. Attach continuous wall brackets securely to walls using anchor devices.
- C. Attach panels and pilasters to continuous brackets.
- D. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.
- E. No evidence of drilling, cutting or patching shall be visible in the finished work.

3.03 ERECTION TOLERANCES

- A. Section 01 40 00 – Quality Requirements: Tolerances.
- B. Maximum Variation From Indicated Position: 1/4 inch.
- C. All partitions shall be erected straight, level and plumb.
- D. Clearance at vertical edges of door shall be uniform top to bottom and shall not exceed 1/4 inch.

3.04 ADJUSTING

- A. Section 01 70 00 – Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- C. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- D. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 22 26 - MANUALLY OPERATED PAIRED PANEL OPERABLE PARTITIONS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Manually operated, paired panel operable partitions.

1.02 RELATED SECTIONS

- A. Division 5 Sections for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
- B. Division 9 Sections for wall and ceiling framing at head and jambs.

1.03 REFERENCES

- A. ASTM International
 - 1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E90- Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 3. ASTM E413 – Classification for Rating Sound Insulation.
 - 4. ASTM E557-Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
- B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
- C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.

1.05 SUBMITTALS

- A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
- B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation

requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.

- C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
- D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.
- E. Reports: Provide a complete and unedited written sound test report indicating test specimen matches product as specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
- B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.07 WARRANTY

- A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
- B. Warranty period: Two (2) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a Standard of Quality. Other acceptable manufacturers with products having equivalent characteristics may be considered provided deviations are minor and do not change concept as expressed in Contract Documents as judged by the Architect.
 - 1. Basis of Design:
 - a. Manufacturer: Modernfold, Inc.
 - b. Product: Acousti-Seal Legacy #932 manually operated paired panel operable partition.
- B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents provide product: by one of the manufacturers below:
 - 1. Hufcor.
 - 2. Panelfold.

2.02 OPERATION

- A. Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals.

- B. Final Closure:
 - 1. Hinged panel closure

2.03 PANEL CONSTRUCTION

- A. Nominal 3-inch thick panels in manufacturer's standard 48-inch widths. All panel horizontal and vertical framing members fabricated from minimum 18-gage or 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
- B. Panel Skin:
 - 1. Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction:
 - a. 52 STC
- C. Hinges for Closure Panels, and Pocket Doors shall be:
 - 1. Full leaf butt hinges, attached directly to panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
- D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.
- E. Panel Weights, Steel Skin:
 - 1. 52 STC - 11 lbs./square foot

2.04 PANEL FINISHES

- A. Panel face finish shall be:
 - 1. Reinforced heavy duty vinyl with woven backing weighing not less than 30 ounces per lineal yard as selected by Architect.
- B. Panel trim: Exposed panel trim of one consistent color from manufacturer's standard offering.

2.05 SOUND SEALS

- A. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.
- B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
- C. Horizontal Bottom Seals:

1. Modernfold IA2 bottom seal: Automatic operable seals providing nominal 2-inch operating clearance with an operating range of +1/2-inch to -1-1/2-inch which automatically drop as panels are positioned, without the need for tools or cranks.

2.06 SUSPENSION SYSTEM

A. #14 Suspension System

1. Suspension Tracks: Minimum 7-gage, 0.18-inch roll formed steel. Track shall be supported by adjustable steel hanger brackets connected to structural support pairs of 1/2-inch diameter threaded rods. Brackets shall support the load bearing surface of the track.
 - a. Exposed track soffit: Steel, removable for service and maintenance, attached to track bracket without exposed fasteners, and pre-painted off-white.
2. Carriers: One all steel trolley with steel-tired ball bearing wheels per panel (except hinged panels). Non-steel tires are not acceptable.
3. Warranty period: Twenty (20) years.

2.07 OPTION

A. Pocket Door:

1. Pocket Doors: Acousti-Seal Pocket Doors by Modernfold, Inc., with same construction, finish, and appearance as the adjacent panels.

PART 3 EXECUTION

3.01 INSTALLATION

- A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
- B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
- C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
- D. Broken, cracked, chipped, deformed, or unmatched panels are not acceptable.

3.02 CLEANING AND PROTECTION

- A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and Installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.03 ADJUSTING

- A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.04 EXAMINATION

- A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.05 DEMONSTRATION

- A. Demonstrate proper operation and maintenance procedures to Owner's representative.
- B. Provide Operation and Maintenance Manual to Owner's representative.

END OF SECTION

SECTION 10 26 00 – WALL PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Corner Guards.
2. Chair Rails.
3. Semi-Rigid Impact-Resistant Wallcoverings.

B. Related Sections:

1. Section 06 10 53 – Miscellaneous Carpentry.
2. Section 09 21 16 – Gypsum Board Assemblies.
3. Section 09 22 16 – Non-Structural Metal Framing: Backing plate and metal stud framing for securing the following:
 - a. Corner guards.
 - b. Chair rails.

C. References:

1. ANSI, American National Standards Institute.
2. ASTM, American Society for Testing and Materials.
3. NFPA, National Fire Protection Association.
4. UL, Underwriters Laboratory.
5. ADA, Americans with Disabilities Act.

1.02 PERFORMANCE REQUIREMENTS

- A. Corner Guards:** Resist lateral impact force of 100 lbs at any point without damage or permanent set.

1.03 SUBMITTALS

- A.** Submit under provisions of Section 01 33 00 – Submittal Procedures.
- B.** Product data indicating compliance with specified requirements. Include physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C.** Shop Drawings showing methods of attachment to substrate and locations of wall

protection.

- D. Samples: Submit one section of wall protection illustrating component design, configuration, selection of color, pattern and surface texture.
 - 1. 12-inch-long samples of each type of, wall and corner guard required. Include examples of joinery, corners, and field splices.
 - 2. 7 by 9-inch samples of each rigid sheet or panel type wall surface protection material required.
 - 3. Provide trim accessories in color to match wall protection. Provide sample for verification to architect prior to ordering.
- E. Manufacturer's Installation Instructions – Indicate installation rough-in measurements and instructions.
- F. Manufacturer's Certificate – Certify that products meet or exceed flame spread rating for surface finish.

1.04 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Proved UL classified wall protection assemblies with NFPA Class A fire rating. Comply with ASTM E 84 for the fire performance characteristics indicated below. Identify components with markings from testing and inspection organization.
 - 1. Flame Spread: 25 or less.
 - 2. Smoke Developed: 450 or less.
- B. Single-Source Responsibility: Obtain wall surface protection system components from a single source.
- C. Deliver materials in original factory wrappings and containers, clearly labeled with manufacturer and brand name.
- D. Store materials in original undamaged packages and containers inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
 - 1. Maintain room temperature within the storage area between 60 degrees F (16 degrees C) and 80 degrees F (27 degrees C) during the period plastic materials are stored. Keep materials out of direct sunlight to avoid excessive surface temperatures.
 - 2. Store rigid plastic corner guard, wall guard, and semi-rigid wall covering attains the ambient room installation temperature of between 65 degrees F (18 degrees C) and 75 degrees F (24 degrees C).
- E. Chemical and Stain Resistance: Provide wall protection system components with chemical and stain resistance in accordance with ASTM D1308.
- F. Color Consistency: Provide components matched in accordance with SAE J-1545-(Delta

E) with a color difference no greater than 1.5 units using CIE Lab, CIE CMC, CIE LCh, Hunter Lab or similar color space scale systems.

- G. Impact Strength: Provide assembled wall protection units that have been tested in accordance with the applicable provisions of ASTM F476.

1.05 PROJECT CONDITIONS

- A. Maintain ambient temperature within building at not less than 65 degrees F (18 degrees C) or greater than 75 degrees F (24 degrees C) for a minimum 72 hours prior to beginning installation.
- B. Do not install wall surface protection system components until the space is enclosed, weatherproof and climate controlled.
- C. Do not install semi-rigid wall protection systems until temperature is stable and permanent lighting is in place.

1.06 MAINTENANCE

- A. Maintenance Instructions: Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.
- B. Replacement materials: Minimum 2 percent of each type, color, and pattern of wall surface protection materials and components. **Include accessory components as required. Replacement materials shall be from the same production run as installed materials. Package with protective coverings and appropriate labels.

1.07 FIELD MEASUREMENTS

- A. Verify field measurement prior to fabrication.

1.08 COORDINATION

- A. Coordinate Work with wall or partition sections for installation of concealed blocking or anchor devices.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Koroseal Wall Protection Systems. Drawings and specifications are based on manufacturer's literature from Koroseal Wall Protection Systems unless otherwise indicated.
- B. Substitutions: Under provisions of Section 01 60 00.

2.02 COMPONENTS

- A. Plastic Sheet Wallcovering Material: Textured, chemical- and stain-resistant, high-impact, acrylic modified vinyl plastic sheets, thickness as indicated. Comply with specified requirements of ASTM D256 for impact resistance and ASTM E84 for flame spread and smoke developed characteristics. Color: As selected by Architect from the manufacturer's

full range of standard colors.

- B. Rigid Plastic Material: Extruded, textured, chemical- and stain-resistant, high-impact, acrylic modified vinyl plastic, thickness as indicated. Comply with specified requirements of ASTM D256 for impact resistance and ASTM E84 for flame spread and smoke developed characteristics. Color: As selected by Architect from the manufacturer's full range of standard colors.
- C. Fasteners: Provide non-corrosive metal screws, bolts, and other fasteners compatible with aluminum components, hardware, anchors, and other items being fastened. Use theft-proof fasteners where exposed to view.

2.03 CORNER GUARDS

- A. Surface-Mounted, Resilient Plastic Corner Guards: CG1, EP1
 - 1. Cover: Rigid, impact-resistant plastic, minimum 0.078 inch (1.9mm) thick, in dimensions and profiles indicated.
 - 2. Retainer: Continuous, one-piece, extruded aluminum retainer, minimum 0.062 inch (1.6 mm) thick.
 - 3. CG#: G100 Series, 2 inch by 2 inch. Height indicated in feet after CG designation; corner Radius: 1/4 inch.
 - 4. EP#: G110 Series, 2 inch by 2 inch. Height indicated in feet after EP designation: high impact filler sheet.
 - 5. Accessories: Prefabricated aluminum retainer with concealed splices, mounting hardware and other accessories as required.
 - a. End Caps:
 - 1) Match plastic cover color.
 - 2) Field adjustable for close alignment with snap-on plastic covers.
 - 6. Color: As selected. Refer to Finish Schedule
 - 7. Screws: As recommended by the manufacturer.

2.04 WALL GUARDS

- A. Chair Rail Type Wall Guard: CR2
 - 1. Model CH20, 2-1/8 inches chair rail with full-length vinyl cover and PVC retainer.
 - 2. Color: As selected. Refer to Finish Schedule.

2.05 IMPACT-RESISTANT WALLCOVERINGS

- A. Semi-rigid, integrally colored Sheet Wallcovering: Semi-rigid, embossed, impact-resistant plastic sheets or roll stock. Comply with fire performance characteristics specified and be chemical- and stain-resistant.
 - 1. 500 Series: Solid Colors.
 - a. Sheet/Roll Thickness: 0.040 inch (1.0 mm) thick, Class I/A Fire-Rated.
 - 2. Color: As Selected. Refer to Finish Schedule.
 - 3. Screws: As recommended by manufacturer.
- B. Color Matched or Complimentary Accessory Moldings: Manufacturer's Standard.
 - 1. J-Molding: #MO82.
 - 2. Divider Bar: #87/88.
 - 3. Inside Corner: #MO83.
 - 4. Outside Corner: #85.
 - 5. Color: As selected.
- C. Color Matched Caulk: Manufacturer's Standard.
- D. Adhesive and Primer: As recommended by the manufacturer.

2.06 FABRICATION

- A. Comply with requirements indicated for design, dimensions, details, finish and member sizes, including wall thicknesses of components.
- B. Shop-assemble components to the greatest extent possible. Disassemble only as necessary for shipping and handling.
- C. Fabricate component with tight seams and joints with exposed edges rolled. Provide surfaces free of evidence of wrinkling, chipping, uneven coloration, dents and other imperfections. Fabricate members and fittings to produce flush, smooth and rigid hairline joints.
- D. Brackets, Flanges, Fittings and Anchors: Provide wall brackets, flanges, miscellaneous fitting and anchors for interconnection of members to other construction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions in which wall surface protection components and wall protection systems will be installed.
- B. Complete finishing operations, including painting, before beginning installation of wall surface protection system materials.

- C. Wall surfaces to receive impact-resistant wallcovering materials shall be dry and free from dirt, grease, loose paint, and scale.
- D. Do not proceed with installations until unsatisfactory conditions have been corrected.
- E. Verify rough-in for components are correctly sized and located.

3.02 PREPARATION

- A. Properly prepare substrate and clean to remove dust, debris and loose particles.

3.03 INSTALLATION

- A. Install wall surface protection units plumb, level and true to line without distortions.
- B. Do not use materials with chips, cracks, voids, stains or other defects that might be visible in the finished work.
- C. Install aluminum retainers, mounting brackets, and other accessories in strict accordance with the manufacturer's instructions.
- D. Where splices occur in horizontal runs of over 20 feet (6 m), splice aluminum retainer and plastic cover at same locations along the run.
- E. Position surface-mounted corner guards atop wall base.
- F. Install semi-rigid vinyl wallcovering sheets with texture running in the same direction for uniform appearance.
 - 1. Provide continuous "J" -molding at all exposed ends of semi-rigid wall covering.
- G. Coordinate installation of vinyl fabric wall covering with corner guard frame and cover.

3.04 ERECTION TOLERANCES

- A. Maximum Variation from Required Height for Horizontal Rails: 1/4 inch (6mm).
- B. Maximum Variation from Level or Plane for Visible Length for Horizontal Rails: 1/4 inch (6 mm).

3.05 CLEANING

- A. Clean plastic covers and accessories using a standard non-ammonia-based household cleaning agent.
- B. Clean metal components in accordance with the manufacturer's recommendations.
- C. Remove excess adhesive in manner recommended by manufacturer.

3.06 PROTECTION

- A. Protect installed materials to prevent damage by other trades.

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END OF SECTION

SECTION 10 28 00 – TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Toilet, washroom accessories.
- B. Grab bars.
- C. Attachment hardware.
- D. Molded pipe insulation.
- E. Baby changing station.

1.02 RELATED SECTIONS

- A. Section 06 10 53 – Miscellaneous Carpentry: Wood backing.
- B. Section 09 22 16 – Non-Structural Metal Framing: Wood and steel backing.
- C. Section 10 21 15 – Plastic Toilet Compartments.

1.03 REFERENCES

- A. ASTM International:
 - 1. ASTM A125/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 3. ASTM A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - 4. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM A666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 6. ASTM B456 – Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - 7. ASTM C1036 – Standard Specification for Flat Glass.
 - 8. ASTM F2285 – Standard Consumer Safety Performance Specification for Diaper-Changing Tables for Commercial Use.
- B. Federal Specification Unit:

1. FS A-A-3002 – Mirrors, Glass.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide data on accessories describing size, finish, details of function, attachment methods.
- C. Manufacturer's Installation Instructions.

1.05 REGULATORY REQUIREMENTS

- A. Conform to ADA (Americans with Disabilities Act) code for access for the handicapped.

1.06 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on product data.

1.07 COORDINATION

- A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.08 WARRANTY

- A. Baby Changing Station: Manufacturer's 5-year limited warranty.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ASI.
- B. Bobrick Washroom Equipment, Inc.
- C. Bradley Inc.
- D. Truebro, Inc. Model No. 102.
- E. Koala Kare Products.
- F. Standard Textile (Shower curtains).
- G. Substitutions: Under provisions of Section 01 60 00.

2.02 MATERIALS

- A. Sheet Steel: ASTM A366.
- B. Stainless Steel Sheet: ASTM A666, Type 304.

- C. Tubing: ASTM A269, stainless steel.
- D. Mirror Glass: Float glass, Type I, Class 1, Quality q1 (ASTM C1036), with silvering, copper coating, and suitable protective organic coating to copper backing in accordance with FS A-A-3002.
 - 1. Provide tempered glass.
- E. Adhesive: Two-component epoxy type, waterproof.
- F. Fasteners, Screws and Bolts: Hot-dip galvanized, tamper-proof.
- G. Expansion Shields: Fiber, lead or rubber as recommended by accessory manufacturer for component and substrate.
- H. Anchor Plates: Provide grab bar manufacturer's standard anchor plates for grab bar installation required. Anchor plates shall be a minimum of 12-gauge steel with mounting holes.
- I. Piping Insulation: Fully molded, closed-cell vinyl, complying with ASTM D635 for burning characteristics and ASTM C177, thermal conductivity.
- J. Baby Changing Station:
 - 1. Hinges: Reinforced, steel-on-steel hinge mechanism and metal mounting hardware.
 - 2. Operation: Hidden pneumatic cylinder for safe open/close motions.
 - 3. Microban Antimicrobial: Stable, embedded antimicrobial technology, which inhibits the growth of bacteria. Antimicrobial claim shall be substantiated by standard industry test methodology equal to Kirby-Baver test.
 - 4. Material: Molded FDA-approved high-density polyethylene (HDPE).
 - 5. Accessories:
 - a. Molded graphic instructions and safety messages in 6 languages.
 - 6. Integral, built-in liner dispenser for use with 3-ply chemical-free biodegradable bed liners.
 - 7. Door Decal.
 - 8. Hardware Kit.

2.03 FABRICATION

- A. Weld and grind joints of fabricated components, smooth.
- B. Form exposed surfaces from single sheet of stock, free of joints. Form surfaces flat without distortion. Maintain surfaces without scratches or dents.

- C. Fabricate grab bars of tubing, free of visible joints, return to wall with end attachment flanges. Form bar with 1-1/2 inches clear of wall surface. Knurl grip surfaces.
- D. Shop assemble components and package complete with anchors and fittings.
- E. Provide steel anchor plates, adapters and anchor components for installation.

2.04 KEYING

- A. Master key all accessories; supply 6 keys to Owner.

2.05 FINISHES

- A. Galvanizing: ASTM A123 to 1.25 oz/sq.yd. Galvanize ferrous metal and fastening devices.
- B. Shop Primed Ferrous Metals: Pre-treat and clean, spray apply one coat primer and bake.
- C. Chrome/Nickel Plating: ASTM B456, Type SC 2 satin finish.
- D. Stainless Steel: No. 4 satin luster finish.
- E. Back paint components where contact is made with building finishes to prevent electrolysis.
- F. Molded Pipe Insulation: Light Grey.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that site conditions are ready to receive work and dimensions are as instructed by the manufacturer.
- B. Verify exact location of accessories for installation.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions and ADA.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. At all specified "handicapped" lavatories, provide molded insulation at P-traps and hot and cold-water angle valves.

3.04 SCHEDULE (Note: Toilet accessories listed are based on products from Bobrick unless otherwise

indicated.)

*Not all products listed may be used. Refer to Drawings.

- TA-1 Grab bar: B-6806.99 Length as indicated in Drawings (NOTE: In locations where the flush valve conflicts with the grab bar, the rear grab bar shall be 36" long and located on the open side of the toilet area. Center the grab bar between the flush control and the wall or lavatory)
- TA-2 Not Used
- TA-3 Grab bar: For 36" x 36" shower compartment; B-6861.99
- TA-4 Grab bar: For 30" x 60" roll-in shower compartment: B-6806.99 – Custom Fabrication. Size to comply with Sheet G2.2 and/or G3.2 as applicable to project.
- TA-5 Surface mounted single roll toilet tissue dispenser: B-2730
- TA-6 Surface mounted dual roll toilet tissue dispenser: B-2740
- TA-7 Surface mounted soap dispenser: B-2111, 40 oz. capacity.
- TA-8 Steel channel frame tempered mirror, custom size, B-1658-1840.
- TA-9 Steel channel frame tempered mirror, custom size, B-1658-3636.
- TA-10 Toilet partition mounted napkin disposal: B-354 serves two compartments.
- TA-11 Toilet partition mounted napkin disposal: B-254 serves one compartment.
- TA-12 Surface-mounted sanitary napkin disposal: B-270.
- TA-13 Recessed Sanitary Napkin/Tampon Vendor: B-352, .25-coin operation.
- TA-14 Robe Hook: B-7671
- TA-15 Utility Shelf: B-224, 4 holders, 3 hooks
- TA-16 Recessed Combination Towel Dispenser/Waste Receptacle. Model B-3944, 12 gal. capacity
- TA-17 Surface-Mounted Paper Towel Dispenser: Model B-262.
- TA-18 Shower Rod: B-6047

NOTE: Mount the bottom of the shower rod at 81 inches above the shower floor at transfer showers, roll in showers and non-accessible showers.
- TA-19 Shower Curtain Hook: B-204-1
- TA-20 Shower Curtain at Transfer Showers and 36-inch-wide Non-Accessible Shower Stalls:

Manufacturer: Standard Textile
Pattern: Bezel CM7681 or Matrix CM7683
100 percent FR Polyester
Passes Cal 19 & NFPA 701
Mildew Resistant, Liquid Resistant and Machine Washable
Fastener Support: Metal grommets
Color: As selected by Architect

Width: 42 inches
Length: Length as required in order that the bottom of the curtain is 1 inch above the shower floor.
Number of hooks: 7

TA-21 Shower Curtain at Roll in Showers:

Manufacturer: Standard Textile
Pattern: Bezel CM7681 or Matrix CM7683
100 percent FR Polyester
Passes Cal 19 & NFPA 701
Mildew Resistant, Liquid Resistant and Machine Washable
Fastener Support: Metal grommets
Color: As selected by Architect

Width: 70 inches.
Length: Length as required in order that the bottom of the curtain is 1 inch above the shower floor.
Number of Hooks: 12.

TA-22 Folding Shower Seat: B-5181 reversible for right or left-hand field installation.

TA-23 Baby Changing Station: Horizontal design surface-mounted with molded Braille instructions, Model KB200-00 crème, 200-lb. capacity. Station shall protrude not more than 4 inches when closed. Provide sanitary bed liners, Model KB150-99.

TA-24 Recessed Specimen Pass-Through Cabinet: Type 304 stainless steel; Model B-505.

TA-25 Surface Mounted Twin Jumbo Roll Toilet Tissue Dispenser: OFCI.

TA-26 Automatic Roll Towel Dispenser: Model B-72974.

TA-27 Surface Mounted Waste Receptacle: Model B-279.

TA-28 Electric Hand Dryer: World Dryer VERDEdri, Hi-speed Surface Mounted ADA compliant hand dryer, Q-972A, polished stainless-steel cover with the following features.

Size: 13.3 inches high by 11.6 inches wide by 3.9 inches deep.
Voltage: Universal controls accepting 115/208/230 VAC.
12 second dry time.
Replaceable HEPA filter.
Air flow, 64 CFM.
Air velocity, 225 MPH (19,800 LFM).

Activate by automatic infrared sensor with 30 second vandal shut-off.
Provide HI/LOW speed control.
Dryer to provide exit air temperature of 130-degree F. at ambient air 70-degree F.
Dryer to have an ingress protection rating of minimum IP 24.
IP = International Protection Rating or Ingress Protection Rating.
First Digit 2 = Protected from touch by fingers and objects greater than 12 millimeters (0.472 inches).
Second digit 4 = Splashing water, protected from water spray from any direction.

END OF SECTION

SECTION 10 44 00 – FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. This Section Includes the Following:
 - 1. Fire extinguisher cabinets, non-rated.
 - 2. Fire extinguishers.
 - 3. Fire extinguisher mounting brackets.

1.02 RELATED SECTIONS

- A. Section 09 22 16 – Non-Structural Metal Framing: Rough opening in metal stud walls.

1.03 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 10 – Standard for Portable Fire Extinguishers.
- B. Underwriters Laboratories Inc.:
 - 1. UL – Fire Protection Equipment Directory.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Product data for each type of product specified. For fire extinguisher cabinets include rough-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type and materials, trim style, door construction, panel style, and materials.

1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility: Obtain fire extinguisher cabinets from one source from a single manufacturer.

1.06 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit test, refill or recharge schedules and re-certification requirements.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements: Environmental conditions affecting products

on site.

- B. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. J.L. Industries.
2. Larsens Manufacturing Co.
3. Walter Kidde, Division of Kidde, Inc.

Model numbers listed in the schedule at the end of this section are based on Larsens Manufacturing Co., Architectural Series.

2.02 FIRE EXTINGUISHER CABINETS

- A. General: Provide fire extinguisher cabinets where indicated.
- B. Construction: Manufacturer's standard enameled steel box, with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Weld all joints and grind smooth. Miter and weld perimeter door frames.
- C. Cabinet Type: Suitable for mounting conditions indicated, of the following types:
 1. Semi Recessed: Cabinet box (tub) semi recessed in walls of sufficient depth to suit style of trim indicated. Total recessed depth for box shall not 4" for non-rated FEC-1 cabinets. Cabinet trim may not project more than 4" from wall surface.
- D. Trim Style: Fabricate trim in one piece with corners mitered, welded and ground smooth.
 1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (back bend).
 - a. Rolled edge semi-recessed with 2-1/2" backbend depth.
 - b. Trim Metal: Enameled steel.
- E. Door Material and Construction: Manufacturer's standard door construction, of material indicated, coordinated with cabinet types and trim styles selected.
 1. Enameled Steel: Manufacturer's standard finish.
- F. Door Style: Full flush opaque panel of material indicated.

- G. Identify fire extinguisher in cabinet with "**FIRE EXTINGUISHER**" lettering vertically on door in die-cut letters, red in color.
- H. Identify bracket-mounted extinguishers with "**FIRE EXTINGUISHER**" in red letter decals applied to wall surface. Use letter size, style and location as selected by Architect.
- I. Door Hardware: Provide manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide concealed or continuous-type hinge permitting door to open 180 degrees. Provide recessed handle and "Larsen Loc."

2.03 FINISHES FOR FIRE EXTINGUISHER CABINETS – GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by application of strippable, temporary protective covering prior to shipment.

2.04 STEEL FIRE EXTINGUISHER CABINET FINISHES

- A. Surface Preparation: Solvent-clean surfaces in compliance with SSTs-SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncooked steel in compliance with CPC-SP 5 (White Metal Blast Cleaning) or CPC-SP 8 (Pickling).
- B. Baked Enamel Finish: Immediately after cleaning and pretreatment, apply manufacturer's standard 2-coat baked enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's instructions for application and baking to achieve a minimum dry film thickness of 2.0 mils.
 - 1. Color and Gloss: As selected by Architect from manufacturer's standard choices for color and gloss, paint exterior and interior of cabinet.

2.05 FIRE EXTINGUISHER

- A. General: Provide fire extinguishers for each cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard, that comply with authorities having jurisdiction.
- B. Dry Chemical Type, (DC10): UL-rated 60B:C, 10-lb nominal capacity, in enameled steel container.
- C. Multipurpose Dry Chemical Type, (MP10): UL-rated 4-A: 80B:C, 10-lb nominal capacity, in enameled steel container.
- D. Ansul Clean Agent Fire Extinguisher, FE36: UL rated 2-A:10-B:C, Model FE13 as distributed by Koetter Fire Protection.

2.06 MOUNTING BRACKETS

- A. Brackets: Designed to prevent accidentally dislodging extinguisher, of sizes required for

type and capacity of extinguisher indicated, in plated finish.

1. Provide standard brackets for each type of extinguisher not located in cabinets.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install items included in this section in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities. Examine walls and partitions for thickness and framing for cabinets to verify cabinet depth and mounting prior to cabinet installation.
 1. Prepare recesses in walls for fire extinguisher cabinets as required by type and size of cabinet and style of trim and to comply with manufacturer's instructions.
 2. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb, to comply with manufacturer's instructions.
 3. Where exact location of bracket-mounted fire extinguishers is not indicated, locate as directed by Architect.

3.02 SCHEDULE

- A. Provide the following:
 1. Non-Fire-Rated Fire Extinguisher Cabinet (**FEC-1**): Larsens **2409-6R**. Manufacture cabinet with 2-1/2" return trim. Mount bottom of cabinet at 2'-0" above finished floor. Provide and install an **MP10** fire extinguisher in each cabinet.
 2. Fire Extinguisher One (**FE1**)-**DC10**, dry chemical type with standard bracket. Mount bracket at 36 inches above finish floor.
 - a. Install one wall-mounted fire extinguisher in the following spaces:
 - 1) Electrical Rooms
 3. Fire Extinguisher Two (**FE2**)-Ansul Clean Agent **FE36** with standard bracket. Mount bracket at 36 inches above finish floor
 - a. Install one wall-mounted fire extinguisher at the following rooms:
 - 1) MDF

END OF SECTION

SECTION 10 51 00 – METAL LOCKERS

PART 1 GENERAL

1.01 SUMMARY

- A. This Section includes the following:
 - 1. Metal lockers and accessories.
 - 2. Provide fasteners and anchorage devices to install lockers provided under this section.
 - 3. Provide metal filler panels to fill between banks of lockers and adjacent construction.

1.02 RELATED SECTIONS

- A. Section 06 10 53 – Miscellaneous Carpentry: Wood blocking.

1.03 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.
- B. Shop Drawings: Show lockers in detail, method of installation, fillers, trim, base and accessories. Include locker numbering sequence information.
- C. Samples: Submit four 3-inch by 6-inch samples of each color selected.
- D. Maintenance Data: For adjusting, repairing and replacing locker doors and latching mechanisms to include in maintenance manuals specified in Division 1.

1.04 QUALITY ASSURANCE

- A. Uniformity and Single Manufacturer Requirements: Provide each type of metal locker as produced by a single manufacturer, including necessary mounting accessories, fittings and fastenings.
- B. Installer's Qualifications: Lockers to be installed by an experienced agent of the manufacturer.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: Do not deliver metal lockers until building is enclosed and ready for locker installation.
- B. Storage and Protection: Protect materials from damage during delivery, handling, storage and installation.

1.06 WARRANTY

- A. Locker manufacturer shall warrant the lockers for the lifetime use of the original

purchaser from date of shipment. Warranty shall include all defects in material and workmanship, excluding finish, vandalism and improper installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS/PRODUCTS

- A. Basis of Design: Contract Documents are based on manufacturer and product named. Other acceptable manufacturers with products listed in Paragraph B below having equivalent products may be submitted.
 - 1. Basis of Design Manufacturer: DeBourgh Manufacturing Company.
 - 2. Product: Core Hallway Corridor All-Welded Locker.
 - 3. Size:
 - a. Width by depth:
 - 1) 12 inches wide by 12 inches deep
 - b. Door height:
 - 1) 12 inches wide by 24 inches high
 - c. Tier:
 - 1) Three tier
- B. Acceptable Manufacturers and Products: Subject to compliance with requirements of Contract Documents, provide products by one of the manufacturers listed below.
 - 1. Lyon, All-Welded Lockers.
 - 2. Penco, All-Welded Lockers.

2.02 FABRICATION

- A. Locker Construction:
 - 1. Lockers to be welded unibody construction with exposed welds sanded smooth.
 - 2. No bolts, screws or rivets used in assembly of locker units.
 - 3. Ship lockers set-up, ready to be anchored in place in accordance with manufacturer's instructions.
- B. Body of Lockers:
 - 1. Tops, bottoms and sides: Exterior sides constructed of 16 gauge domestic cold-rolled sheet steel for maximum durability with 18 gauge intermediate partitions.

2. Backs: Solid sheet of 18 gauge cold-rolled sheet steel welded to frames of sides and intermediate partitions.
 3. Shelves and intermediate partitions: Constructed of 18 gauge cold-rolled sheet steel welded to sides and intermediate partition construction.
 - a. At designated accessible lockers provide one shelf at 15 inches above the finished floor.
 - 1) If accessible lockers are not shown on the documents, a minimum of 5 percent of each type of single tier and double tier lockers shall have a shelf located as noted above.
 4. Tier dividers: Full depth 16 gauge cold rolled steel securely welded on all four sides, to combine with tops, bottoms, sides, and intermediate partitions to create four-sided continuous door strike.
- C. Continuous Door Strike:
1. Tier dividers, tops and bottoms constructed to provide four-sided, continuous door strike for a secure, sanitary and intrusion-free locker while door is in closed position.
- D. Doors:
1. Doors are 16 gauge steel, formed outer panel with double bends on both sides and a single bend on top and bottom with 18 gauge steel formed stiffener panel.
 2. Door stiffener runs top to bottom on hinge side of door and is securely welded to outer door to form a reinforced channel for additional torque-free strength and sound reduction when closing door. (Inner panel not available on 12-inch-high box lockers.) Door stiffener to cover at least 40 percent of the door back.
- E. Door Ventilation:
1. Secur-N-Vent doors with three-dimensional vertical vents formed on fronts and backs of door providing 21 percent ventilation per square inch.
- F. Latching
1. Sentry III Single Point Latch
 - a. Eleven gauge unbreakable stationary latch welded to the locker frame extending through no more than 1-1/4 inches into locker opening.
 - b. Latch protrudes through flush-mounted, recessed stainless steel cup.
 - c. Capable of accepting padlock or built-in lock.
- G. Hinges:
1. 16 gauge continuous piano hinge on the right side of the opening.
 2. Hinges welded to door and riveted to locker frame with no fewer than 4 rivets per hinge.

H. Slope Tops:

1. Provide 18 gauge all welded slope top with 25 degree pitch, attached at factory with concealed fasteners. Slope top to be in addition to standard 16 gauge flat top.

I. Closed Base:

1. Provide 4 inch high, 14 gauge welded steel base enclosed on all four sides, securely welded to locker bottom.

J. Filler Panels: Manufacturer's standard fabricated from 18 gauge solid steel finished to match lockers.

K. Finish:

1. Complete locker unit to be thoroughly cleaned, phosphatized and sealed.
2. Finish to be baked pure TGIC polyester powder coat with a minimum 2-3 mil thickness.
3. Color of lockers shall be chosen from manufacturer's 27 standard colors.

2.03 LOCKER ACCESSORIES

A. Hooks:

1. Hooks to be heavy-duty forged steel with ball ends and zinc plated.
2. Provide two single wall hooks and one double ceiling hook in each locker opening 20 inches or taller.

B. Numbering

1. Furnish each locker with polished aluminum number plate with etched black numbers.
2. Locate number plate near center of each door.
3. Owner to furnish numbering sequence.

PART 3 EXECUTION

3.01 INSTALLATION

A. Wall Installation:

1. Securely anchor every locker to wall and/or floor before use.
2. Anchoring to be determined by conditions at time of installation.
3. The adjacent locker units by bolting at four points, two at top and two at bottom,

using 1/4-inch cadmium-plated bolts.

3.02 ADJUSTING

- A. General Requirements: Upon completion of installation, inspect lockers and adjust for proper door and locking mechanism operation.

3.03 CLEANING

- A. General Requirements:
 - 1. Clean interior and exposed exterior surfaces, removing debris, dust, dirt and foreign substances on exposed surfaces.
 - 2. Touch up scratches and abrasions to match original finish.
 - 3. Polish stainless steel and non-ferrous metal surfaces.
 - 4. Replace locker units that cannot be restored to factory-finished appearance.
 - 5. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION

SECTION 10 73 26 – WALKWAY COVERINGS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Design, fabrication and installation of welded extruded aluminum:
 - 1. Entry Canopies.
- B. Products Furnished but not Installed Under this Section: Column sleeves (Styrofoam blockouts) or anchor bolts (if required)

1.02 REFERENCES

- A. The Aluminum Association (AA):
 - 1. The Aluminum Design Manual, Specifications & Guidelines for Aluminum Structures.
- B. American Architectural Manufacturers Association (AAMA):
 - 1. AAMA 2604, Voluntary Specification, Performance Requirements and Test Procedures for High Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. American Society of Civil Engineers (ASCE):
 - 1. ASCE 7, Minimum Design Loads for Buildings and Other Structures.
 - a. Refer to the applicable building code for the effective date.
- D. American Society for Testing and Materials (ASTM):
 - 1. ASTM B209, Specification for Aluminum and Aluminum- Alloy Sheet and Plate.
 - 2. ASTM B221, Specification for Aluminum and Aluminum- Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. ASTM C150, Specification for Portland Cement.
 - 4. ASTM C404, Specification for Aggregates for Masonry Grout.
- E. American Welding Society (AWS):
 - 1. ANSI/AWS D1.2, Structural Welding Code - Aluminum.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Design Walkways in accordance with current The Aluminum Design Manual.

2. Comply with the wind requirements of ASCE 7.
 3. Provide an all-welded extruded aluminum system complete with internal drainage. Non-welded systems are not acceptable.
 4. Provide expansion joints to accommodate temperature changes of 120 degrees F. Provide expansion joints with no metal-to-metal contact.
 5. Refer to Structural Drawings for:
 - a. Wind speed.
 - b. Exposure.
 - c. Importance Factor.
- B. Performance Requirements:
1. Grout: Compressive strength of 2000 psi, minimum.

1.04 SUBMITTALS

- A. Product Data: Manufacturer's product information, specifications and installation instructions for:
1. Entry canopy components and accessories.
- B. Shop Drawings: Include plan dimensions, elevations and details.
- C. Samples:
1. Selection: Manufacturer's full range of colors for the finishes selected.
 2. Verification: 3-inch-square samples of each finish selected on the substrate specified.
- D. Design Data: Design calculations bearing the seal of a Registered Professional Engineer, licensed in the State of Texas. Design calculations shall state that the entry canopy design complies with the wind requirements of ASCE 7, the stability criteria of applicable building code, and all other governing criteria.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: At least ten years of experience in the design, fabrication and erection of extruded aluminum entry canopy systems.
- B. Installer Qualifications: Have entry canopies installed by manufacturer; third-party installation is not acceptable.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. The design is based on products fabricated by: AVAdek

1. Comparable products by the following manufacturers also will be acceptable:
 - a. Canopy Solutions.
 - b. Dittmer Architectural Aluminum.
2. Substitutions: Comparable products of other manufacturers will be considered under Section 01 60 00.

2.02 MATERIALS

- A. Aluminum Members: Extruded aluminum, ASTM B221, 6063 alloy, T6 temper.
- B. Fasteners: Aluminum, 18-8 stainless steel, or 300 series stainless steel.
- C. Protective Coating for Aluminum Columns Embedded in Concrete: Clear acrylic.
- D. Grout:
 1. Portland Cement: ASTM C150, Type I.
 2. Sand: ASTM C404.
 3. Water: Potable.
- E. Gaskets: Dry seal santoprene pressure type.
- F. Aluminum Flashing: ASTM B209, Type 3003 H14, 0.040-inch, minimum.

2.03 MIXES

- A. Grout: 1-part Portland cement to 3 parts sand; add water to produce a pouring consistency.

2.04 FABRICATION

- A. General:
 1. Shop Assembly: Assemble components in shop to greatest extent possible to minimize field assembly.
 2. Welding: In accordance with ANSI/AWS D1.2.
 3. Deck Construction: Fabricate from extruded modules that interlock in a self-flashing manner. Positively fasten interlocking joints at 8 inches on center creating a monolithic structural unit capable of developing the full strength of the sections. The fastenings must have minimum shear strength of 350 pounds each. Assemble deck with sufficient camber to offset dead load deflection.
- B. Columns: Provide radius-cornered tubular extrusions with cutout and internal diverter for drainage where indicated. Circular downspout opening in column not acceptable.
- C. Beams: Provide open-top tubular extrusion, top edges thickened for strength and designed to receive deck members in self-flashing manner. Provide structural ties in tops

of all beams.

- D. Deck: Extruded self-flashing sections interlocking into a composite unit. Provide welded plate closures at deck ends.
- E. Fascia: Manufacturer's standard shape. Provide fascia splices where continuous runs of fascia are jointed. Locate splices to be in line with bents and fasten in place on hidden or non-vertical surfaces.
- F. Flashing: Flashing shall be minimum 0.040 aluminum.
- G. Where noted on drawings provide downspouts at entry canopies. Size based on rain fall intensity.
- H. Factory Finishing: Finish designations prefixed by AA comply with system established by the AAMA for designating aluminum finishes.
 - 1. High performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's written instructions.
 - a. Fluoropolymer Two-Coat Coating System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent Hylar polyvinylidene fluoride resin by weight; complying with AAMA 2604.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify that all concrete, masonry and roofing work in the vicinity is complete and cleaned.

3.02 ERECTION

- A. Erect protective cover true to line, level and plumb. Protect aluminum columns embedded in concrete with clear acrylic. Fill downspout columns with grout to the discharge level to prevent standing water. Install weep holes at top of concrete in non-draining columns to remove condensation.
- B. Provide hairline miters and fitted joints.

3.03 CLEANING

- A. Clean all protective cover components promptly after installation.

3.04 PROTECTION

- A. Protect materials during and after installation.

3.05 SCHEDULE

- A. Refer to drawings for size of members.

END OF SECTION

SECTION 10 90 00 – HIGH SECURITY ENTRY SYSTEM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. High Security Entry System for:
 - 1. Hinged door key box.

1.02 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Product Data: Provide information and manufacturers installation instructions.
- C. Department Registration Forms: Provide local fire department copies of registration forms for each of the products listed.

1.03 QUALITY ASSURANCE

- A. Products listed in this section shall be UL listed.

1.04 DELIVERY, STORAGE AND PROTECTION

- A. Deliver to project site in shipping containers.

1.05 PROJECT CONDITIONS

- A. Coordinate High Security Entry System installation with locations noted on Drawings.
- B. Coordinate with local fire departments to get exact locations and key requirements.

PART 2 PRODUCTS

2.01 HIGH SECURITY ENTRY SYSTEM

- A. Manufacturer: Knox Company
- B. Products:
 - 1. Entry Box: Recessed mounted, hinged- door, 3272 with 3290 recessed mounting kit for masonry construction.
 - 2. For each entry system provide the fire department with appropriate keys and keywrenches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that adjacent materials installation is complete.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 12 24 13 – MANUAL WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manually operated, roll-up fabric interior window shades including mounting and operating hardware.

1.02 REFERENCES

- A. NFPA 701-99 - Fire Tests for Flame-Resistant Textiles and Films.

1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 - Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product specified, including:
 - 1. Preparation instructions and recommendations.
 - 2. Installation and maintenance instructions.
 - 3. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - 4. Storage and handling requirements and recommendations.
 - 5. Mounting details and installation methods.
 - 6. Typical wiring diagrams including integration of motor controllers with building management system, audiovisual and lighting control systems as applicable.
- C. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to adjacent work.
- D. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings, field verified window dimensions, quantities, type of shade, controls, fabric and color, and include opening sizes and key to typical mounting details.
- E. Selection Samples: For each finish product specified, two complete sets of shade cloth options and aluminum finish color samples representing manufacturer's full range of available colors and patterns.
- F. Verification Samples: For each finish product specified, two complete sets of shade components, unassembled, demonstrating compliance with specified requirements. Shade fabric sample and aluminum finish sample as selected, representing actual product, color, and patterns. Mark face of material to indicate interior faces.
- G. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.
- H. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years of experience in manufacturing products comparable to those specified in this section.
- B. NFPA Flame-Test: Passes NFPA 701. Materials tested shall be identical to products proposed for use.
- C. Mock-Up: Provide a mock-up of one of each type roller shade assembly specified for evaluation of mounting, appearance and accessories.
 - 1. Locate mock-up in window(s) designated by Architect.
 - 2. Do not proceed with remaining work until mock-up is accepted by Architect.
 - 3. Mock-up may remain in place upon acceptance by Architect.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Do not deliver window shades until building is enclosed and construction within spaces where shades will be installed is substantially complete.
- B. Deliver products in manufacturer's original, unopened, undamaged containers with labels intact.
- C. Label containers and shades according to Window Shade Schedule.
- D. Store products in manufacturer's unopened packaging until ready for installation.

1.06 SEQUENCING

- A. Ensure that locating templates and other information required for installation of products of this section are furnished to affected trades in time to prevent interruption of construction progress.
- B. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.07 PROJECT CONDITIONS

- A. Install roller shades after finish work and ambient temperature, humidity and ventilation conditions are maintained at levels recommended for project upon completion.

1.08 WARRANTY

- A. Hardware and Shade Fabric: Manufacturer's standard twenty-five year limited warranty.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 MANUFACTURERS AND PRODUCTS

A. Basis of Design: Contract Documents are based on manufacturer and product named below to establish a Standard of Quality. Other acceptable manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change concept as expressed in Contract Documents as judged by Architect.

1. Basis of Design Selections:

- a. Manufacturer: Draper, Inc.
- b. Product: Manual FlexShade XD

B. Acceptable Manufacturers: Subject to compliance with requirements of Contract Documents, provide product by one of the manufacturers named below. If not named, submit as substitution according to Conditions of the Contract and appropriate Division 1 sections.

1. Manufacturer: MechoShade Systems.

2.02 MANUALLY OPERATED WINDOW SHADES

A. Manually Operated Window Shades with Independent Control: Manually operated, vertical roll-up, fabric window shade with components necessary for complete installation.

- 1. Centered bead chain exit allows for right- or left-hand operation without field modification.
- 2. Fabric spline attachment and new heavy-duty clutch design. Metal tube, with stainless steel bead chain clutch operator on right side, standard, as seen from facing the window inside the room. Left side operator available. Chain tension device included.
- 3. Operating Mechanism: Stainless steel bead chain clutch standard (ivory, grey, black, white or brown polyester available at no extra charge).
- 4. 1/8" steel brackets with reinforcement ribs. Brackets and clutch integrated rotational bearing for ease of operation and noise reduction. Minimum of 5 recessed rivets securing clutch to bracket, 7 on idler. One-piece machined steel primary post 9 mm/.354 diameter. Decorative endcap covers with mechanical attachment included.
- 5. Mounting: Wall or ceiling mounting available for brackets only.
- 6. Headbox Ceiling/Wall style: Aluminum fabrication with removable closure, endcaps and back and top cover piece:
 - a. Finish: Clear anodized.

2.03 FABRIC

- A. Light-Filtering Fabrics:
 - 1. SheerWeave Series PW3500 by Phifer: Vinyl-coated polyester yarn with manufacturer's standard anti-microbial protection woven into 2x2 basket-weave pattern.
 - a. PW3500 Refer to finish schedule
 - 2. Fire Rating: NFPA 701 TM#1(small scale)/NFPA 101 (Class A Rating)/NFPA 701-TM#2 large scale.
 - 3. Bacteria and Fungal Resistance: ASTM G21 and ASTM G22.
 - 4. Openness Factor: Refer to finish schedule
 - 5. Fabric Thickness: 0.036".
 - 6. Fabric Weight: 19.20 ounces per square yard.
 - 7. Color and pattern: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install roller shades level, plumb, square and true. Allow proper clearances for window operation hardware.

3.03 TESTING AND DEMONSTRATION

- A. Demonstrate operation of shades to Owner's designated representatives.

3.04 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch up, repair or replace damaged products before Substantial Completion.

3.05 SCHEDULES

- A. Refer to Drawings for shade types and locations.

END OF SECTION

SECTION 12 48 13 – ENTRANCE FLOOR MATS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Floor mat grid and frame assembly.

1.02 RELATED SECTIONS

- A. Section 03 30 00 – Cast-in-Place Concrete: Grouting frames into recess.

1.03 REFERENCES

- A. American Society for Testing and Materials (ASTM).
- B. The Aluminum Association.
- C. The Carpet and Rug Institute (CRI).
- D. The National Floor Safety Institute (NFSI).

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Procedures for submittals.
 - 1. Product Data: Data indicating mat characteristics, component dimensions, frame and dimensions.
 - 2. Shop Drawings: Indicate dimensions and details for recessed installation.
 - 3. Samples: Two 12 inch by 12 inch samples illustrating pattern, color, finish and frame.
 - 4. Assurance/Control Submittals:
 - a. Certificates: Manufacturer's certificate that products meet or exceed specified requirements.
- B. Section 01 70 00 – Execution and Closeout Requirements: Procedures for closeout submittals.
 - 1. Maintenance Data: Include cleaning instructions and stain removal procedures.

1.05 QUALITY ASSURANCE

- A. Flammability in accordance with ASTM E648, Class 1, Critical Radiant Flux, minimum 0.45 watts/m².
- B. Slip resistance in accordance with ASTM D2047-96, Coefficient of Friction, minimum 0.60 for accessible routes.'

- C. Standard rolling load performance to be 750 lb./wheel (load applied to a solid 5 inches by 2 inches wide polyurethane wheel, 1,000 passes without damage).
- D. Single-Source Responsibility: Obtain floor mats/grids and frames from one source of a single manufacturer.
- E. Utilize superior structural aluminum alloy 6105-T5 for rail components.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the project site ready for use and fabricated in as large sections and assemblies as practical, in unopened original factory packaging clearly labeled to identify manufacturer.

1.07 PROJECT CONDITIONS

- A. Field measurements: Check actual openings for mats/grids by accurate field measurements before fabrication. Record actual measurements on final Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.
- B. For recess application coordinate frame installation with concrete construction to ensure recess and frame anchorage are accurate and that the base is level and flat. Defer frame installation until building enclosure is complete and related interior finish work is in progress.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer: Construction Specialties.
- B. Subject to compliance with project requirements, manufacturer's offering Products which may be incorporated in the Work include the following:
 - 1. Mats, Incorporated, Braintree, MA.
- C. Section 01 60 00 – Product Requirements: Product options and substitutions. Substitutions: Permitted.

2.02 MATERIALS

- A. Aluminum – 6105-T5 for extrusions.
- B. Flexible and prime TPE extrusions.
- C. Tread insert options: Refer to Article 2.05.

2.03 FLOOR MATS/GRIDS

- A. Model and Description: G3 PediTred LP shall be extruded 6105-T5 aluminum alloy, with ½ inch deep multiple tread planks which are joined by an TPE hinge to comprise the overall grid length (traffic-direction). All material shall be perforated to allow drainage,

unless otherwise specified. Supplied in mill finish. Units must withstand 750 lb. wheel loads (load applied to a solid 5 inches by 2 inches wide polyurethane wheel, 1,000 passes without damage).

2.04 MAT/GRID FRAMES

- A. LB: Level Base Frame shall be a 3/4 inch deep recessed frame in 6063-T6 aluminum alloy with a 1/4 inch wide exposed surface. Black TPE trim shall be furnished as required, when standard 1 1/2 inches tread spacing cannot be maintained. Installer shall use recommended latex screed to ensure level base. Frame color shall be supplied in standard mill finish. Mill finish frames in contact with concrete to be primer coated.

2.05 TREAD INSERT OPTIONS

- A. HD MonoTuft HD™ carpet shall meet the Carpet and Rug Institute's standard for indoor air quality. Fibers shall include a minimum of 100, 12 mil monofilament fibers per square inch and colorfast, solution-dyed nylon. Available in one of 19 standard colors as offered by manufacturer. Each carpet fiber and monofilament shall be fusion-bonded to a rigid two-ply backing to prevent fraying and supplied in continuous splice-free lengths. Anti-static carpet fiber shall contain antimicrobial additive and be treated with Scotchgard® to reduce soiling. Carpet weight shall be 33-oz./yd².

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 70 00 – Execution and Closeout Requirements: Verification of existing conditions before starting work.
- B. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
 - 1. Field verify floor recess before fabricating mats.

3.02 INSTALLATION

- A. Vacuum clean floor where mat will be installed.
- B. Install mats and frames in accordance with manufacturer's published instructions in locations indicated on Drawings.
- C. Install mat frames in floor recess flush with finish floor after cleaning of finish flooring.
- D. Adhesive Attachment: Apply adhesive to perimeter of mat, fastening edges and corners securely.
- E. Coordinate top of mat/grid surfaces with bottom of doors that swing across to provide ample clearance between door and mat/grid.

3.03 CONSTRUCTION

- A. Site Tolerances:

1. Maximum Gap Formed at Recessed Frame from Mat Size: 1/4 inch.

3.04 PROTECTION

- A. Vacuum clean mat after installation and protect from traffic.

END OF SECTION

SECTION 12 93 00 - SITE FURNISHINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 specification sections, apply to this section.

1.02 SUMMARY

A. Section Includes:

1. Seating.
2. Trash & recycling receptacles.
3. Pet Waste Station.

B. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for installing pipe sleeves cast, installing anchor bolts cast in concrete footings.
2. Division 31 Section "Earth Moving" for excavation for installing concrete footings.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.

B. LEED Submittals:

1. Product data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of post-consumer and pre-consumer recycled content. Include statement indicating cost for each product having recycled content.
2. Certificated for Credit MR 6, Credit MR 7: Chain of custody certificated indicating that wood components of the site furnishing comply with forest certification requirements. Include documentation that Manufacturer is certified for chain of custody by an FSC accredited certification body. Include statement indicating cost for each certified wood product.

- C. Samples: For each exposed product and for each color and texture specified.

- D. Product Schedule: For site furnishings, use same designations indicated on drawings.

1.04 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For site furnishings:

1. Wood Preservative Treatment: Include certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

1.05 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Trash Receptacle Inner Containers: Five (5) full size units for each size indicated.

PART 2 PRODUCTS

2.01 LUXEMBOURG TABLE & CHAIR

- A. As supplied by Fermob

1. Luxembourg Table

- a. Size: 36" square
- b. Finish: Powdercoated Metal
- c. Color: TBD
- d. Mounting option: Freestanding

2. Luxembourg Arm Chair

- a. Finish: Powdercoated Metal
- b. Color: TBD
- c. Mounting option: Freestanding

2.02 PARALLEL 42 BENCH

- A. As supplied by Landscape Forms

1. Parallel 42 Wedge 30 Unit

- a. Finish: Powdercoated Metal
- b. Color: TBD
- c. Mounting option: Surface Mounted

2. Parallel 42 Left 30 Unit
 - a. Finish: Powdercoated Metal
 - b. Color: TBD
 - c. Mounting option: Surface Mounted

3. Parallel 42 Right 30 Unit
 - a. Finish: Powdercoated Metal
 - b. Color: TBD
 - c. Mounting option: Surface Mounted

2.03 LOLLYGAGGER LOUNGE CHAIR
A. As supplied by LOLL

1. Lollygagger Lounge Chair
 - a. Color: TBD
 - b. Mounting option: Freestanding

2.04 METRIX TRASH & RECYCLING RECEPTACLE
A. As supplied by Anova Furnishings

1. Metrix Trash Receptacle
 - a. Finish: Powdercoated Metal
 - b. Color: TBD
 - c. Mounting option: Freestanding
2. Metrix Recycling Receptacle
 - a. Finish: Powdercoated Metal
 - b. Color: TBD
 - c. Mounting option: Freestanding
 - a. Mounting option: Surface Mounted

2.05 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemished and complying with the following:

1. Rolled or Cold-Finished Bars, Rods, and Wire: ASTM B 211.
 2. Excluded Bars, Rods, Wire, Profiles, and Tubes: ASTM B 211.
 3. Structural Pipe and Tube: ASTM R 429/B 429M.
 4. Sheet and Plate: ASTM B 209.
 5. Castings: ASTM B 26/B 26M.
- B. Steel and Iron: Free of surface blemishes and complying with the following:
1. Plates, Shapes, and Bars: ASTM A 36/A 36 M.
 2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric resistance welded pipe complying with ASTM A 135/A 135M.
 3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
 4. Mechanical Tubing: Cold-rolled, electric resistance welded carbon or alloy steel tubing complying with ASTM A 512, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
 5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
 6. Perforated Metal: From steel sheet not less than 0.120" (3.0mm) nominal thickness; Manufacturer's standard perforation pattern.
 7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
 8. Malleable-iron Castings: ASTM A 47/a 47m, grade as recommended by fabricator for type of use intended.
 9. Gray-iron Castings: ASTM A 48/A 48M, Class 200.
- C. Stainless Steel: Free of surface blemishes and complying with the following:
1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
 2. Pipe: Schedule 40 steel pipes complying with ASTM A 312/A 312M.
 3. Tubing: ASTM A 554.
- D. Wood: Surfaced smooth on four (4) sides with eased edges; kiln dried, free of knots, solid stock of species indicated.
1. Wood Species: Manufacturer's standard.

2. Certified Wood: Fabricate site furnishings with components produced from wood obtained from forests certified by an FSC accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
 3. Finish: Manufacturer's standard transparent wood preservative treatment and sealer.
- E. Fiberglass: Multiple laminations of glass fiber reinforced polyester resin with UV light stable, colorfast, non-fading, weather and stain resistant, colored polyester gel coat, and with Manufacturer's standard finish.
- F. Plastic: Color impregnated, color and UV light stabilized, and mold resistant.
1. Polyethylene: Fabricated from virgin plastic HDPE resin.
- G. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion resistant coated or non-corrodible materials appropriate for the type of materials that it abuts; commercial quality, tamperproof, vandal and theft resistant, concealed, recesses, and capped or plugged.
1. Angle Anchors: For inconspicuously bolting legs of site furnishings to on and below grade substrate; per Manufacturer's recommendation. Extend fasteners through pavers from concrete base when installed in a paver (brick, concrete, stone, etc.) surface.
- H. Non-shrink Non-metallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by Manufacturer, for exterior applications.
- I. Erosion Resistant Anchoring Cement: Factory packaged, non-shrink, non-staining, hydraulic controlled expansion cement formulation for mixing with potable water at project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by Manufacturer, for exterior applications.
- J. Retain "Galvanizing" paragraph below if ferrous components are used to fabricate site furnishings.
- K. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication.
1. Hot Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

2.06 WOOD PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment: Pressure treat wood according to AWPA U1 and the following:
1. Use preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.

2. Kiln dry lumber and plywood after treatment to a maximum moisture content, respectively, of 19% and 15%. Do not use materials that are warped or do not comply with requirements for untreated materials.

2.07 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with cull length, full penetration welds and hollow members with circumference welds. At expose connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matched contours adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jugs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Preservative-treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M\$ to cut surfaces.
- E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.
- F. Factory Assembly: Assemble components in the factory greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.08 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.

2.09 ALUMINUM FINISHES

- A. Baked Enamel, Powder-coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish Manufacturer's written instructions for surface preparation, including pre-treatment, application, baking, and minimum dry film thickness.

2.10 STEEL AND GALVANIZED STEEL FINISHES

- A. Baked Enamel, Powder-coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish Manufacturer's written instructions for surface preparation, including pre-treatment, application, baking, and minimum dry film thickness.

- B. PVC Finish: Manufacturer's standard, UV light stabilized. Mold-resistant, slip-resistant, matte textured, dipped or sprayed on, PVC plastisol finish, with flame retardant added; complying with coating Manufacturer's written instructions for pre-treatment, application, and minimum dry film thickness.

2.11 IRON FINISHES

- A. Baked Enamel, Powder-coat Finish: Manufacturer's standard, baked, polyester, powder-coat finish complying with finish Manufacturer's written instructions for surface preparation, including pre-treatment, application, baking, and minimum dry film thickness.

2.12 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished finishes: Grind and polish surfaces to produce uniform finish, free of cross hatches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions, with installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

- A. Comply with Manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishing where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operation until concrete is sufficiently cured.
- E. Posts set into Voids in Concrete: Form or core drill-holes for installing posts in concrete to depth recommended in writing by Manufacturer of the site furnishings and 3/4" (19mm) larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between

post and concrete with non-shrink, nonmetallic grout, mixed and placed to comply with anchoring material Manufacturer's written instructions, with top smoothed and shaped to shed water.

- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with non-shrink, non-metallic grout, mixed and placed to comply with anchoring material Manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION 12 93 00

SECTION 13 31 23 - PRE-ENGINEERED SHADE STRUCTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 1 Specification Sections apply to this section.

1.2 SUMMARY

- A. The shade structure contractor shall be responsible for the design, engineering, fabrication, supply, and installation (including foundations) of the work specified herein. The intent of this specification is to have only one single contractor be responsible for all the above functions.

1.3 REFERENCES

- A. Shade Structures must comply with the latest revision of applicable codes and regulations including IBC 2015.
- B. American Society for Testing Materials (ASTM)
- C. American Welding Society: Structural Welding Code AWS D1.1: Symbols for Welding and Nondestructive Testing AWS 2.3.
- D. International Accreditation Services (IAS)
- E. American Institute of Steel Construction (AISC): Specifications for the design, fabrication, and erection of structural steel.

1.4 SUBMITTALS

- A. Provide proof of installed reference sites with six structures for similar scope of project and installation that are engineered to IBC Specifications.
- B. Provide proof of a minimum of 6 permitted shade structure projects with the City of San Antonio, including Special Inspections and Permit Close-Out.
- C. Provide a minimum of 13 fabric samples to demonstrate fabric color range and powder color selections.
- D. Provide proof of all quality assurance items including:
 - 1. A list of at least three reference projects of similar type structures that have been installed in the last 10 years as described below in 2.1 General, Scope.
 - 2. Proof of general liability, professional liability, and umbrella insurance as per section 1.5 D.
 - 3. Proof of a minimum of \$25,000,000 aggregate bonding capacity as per Section 1.5 E.
 - 4. Proof of IAS Certification per Section 1.5 F.
 - 5. Proof of current status as an ISNetworld Member Contractor.
 - 6. Proof of a Corporate Safety Program along with an Injury & Illness Prevention Program.
 - 7. Proof of Corporate Quality Control Manual as per Section 1.5 H
 - 8. Proof of Maintenance Program and 3 reference projects where maintenance has been provided, where necessary, during the duration of the warranty.

1.5. QUALITY ASSURANCE

Fabrication and erection are limited to firms with proven experience in design and construction of fabric shade structures and such firms shall meet the following minimum requirements. No substitutions shall be allowed for the following:

- A. A single shade contractor shall design, engineer, manufacture, and erect the fabric shade structures and foundations. Contractor shall obtain permits through the local city agencies,

- including electrical permit where required, including special inspections, payment & performance bonds and close-out of permitted project with local agency.
- B. All bidders shall have at least 15 years' experience in the design, engineering, manufacturing, and installation of shade structures.
 - C. All bidders shall engineer to IBC 2015 requirements with similar scope.
 - D. All bidders shall be able to provide proof of a minimum of \$1,000,000 general/public liability insurance, \$3,000,000 professional liability (PL) insurance, and an additional \$10,000,000 umbrella/excess liability insurance.
 - E. All bidders shall be licensed and bonded with a minimum bonding capacity of \$6,000,000 and aggregate bonding capacity of \$25,000,000.
 - F. Steel manufacturer shall be accredited by IAS (International Accreditation Service) for Structural Steel Fabrication under UBC 97 & 2000 Section 1701.7 and IBC 2015 Section 1704.2.2.
 - G. Proof of current status as an ISNetworld Member Contractor.
 - H. The shade contractor shall have a Corporate Quality Control program and manual describing their complete quality assurance program.
 - I. All bidders must have an in-house warranty & service department and local office to assist in repairs and service calls within 48 hours.

1.7 WARRANTY

- A. The successful bidder shall provide a 12-month warranty on all labor and materials.
- B. A supplemental warranty from the manufacturer shall be provided for a period of 10 years on fabric and 10 years on the structural integrity of the steel from the date of substantial completion.
- C. The warranty shall not deprive the Owner of other rights under the provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 PRODUCTS

2.1 GENERAL

- 1. Scope:
Provide (4) Joined 3-Point Sails, measuring 15' x 15' x 15' each with 8' and 10' entry height per CON-JUL-056-21 (1000). Columns shall measure a minimum of HSS 8.625 x .322 and HSS 8.625 x 0.280. The framing shall support a combination of 4 fabric sails. No exceptions.
- A. The structures shall be manufactured by Shade Structures, Inc. dba USA SHADE & Fabric Structures, or approved equivalent and include the structural steel frame, fabric roof, steel cables, all fasteners, and installation. Project management and foundations will also be included.

Contact: Shade Structures, Inc.
Dba USA SHADE & Fabric Structures
2580 Esters Blvd, Suite 100
DFW Airport, TX 75261
Contact Name: Michelle Botha – Phone: 512-937-6430
mbotha@usa-shade.com

- B. To qualify as an approved equivalent, please submit product documentation, fabric samples and all quality assurance criteria as per Section 1.4 at least 10 days prior to bid date. Approved equals will be issued per addendum prior to bid date.
- C. The shade structure shall conform to the current adopted version of the IBC 2015 and local agency additions and amendments.
- D. All shade structures are engineered and designed to meet a minimum of 115 mph wind load, Exposure C, live load of 5 lbs/sf² and a 5 lbs/sf² snow load. When ASD Steel Design Method is used based on IBC 2015 Section 1605.3.1, the Dead + 0.75 of Live + 0.75 of Wind Load cases must be combined. NO EXCEPTIONS.
- E. Steel:
 - 1. All steel members of the shade structure shall be designed in strict accordance with the requirements of the "American Institute of Steel Construction" (AISC) Specifications and the "American Iron and Steel Institute" (AISI) Specifications for Cold Formed Members and manufactured in a IAS (International Accreditation Service) accredited facility for Structural Steel Fabrication as per IBC 2015 Section 1704.2.2.
 - 2. All connections shall have a maximum internal sleeving tolerance of .0625 inches using high tensile strength steel sections with a minimum sleeve length of 6 inches.
 - 3. All non-hollow structural steel members shall comply with ASTM A-36. All hollow structural steel members shall be cold formed, high strength steel and comply with ASTM A-500, Grade C. All steel plates shall comply with ASTM A-572, Grade 50. All galvanized steel tubing shall be triple coated for rust protection using an in-line electro-plating coat process. All galvanized steel tubing shall be internally coated with zinc and organic coatings to prevent corrosion.
- F. Welding:
 - 1. All shop-welded connections of the shade structure shall be designed and performed in strict accordance with the requirements of the "American Welding Society" (AWS) Specifications. Structural welds shall be made in compliance with the requirements of the "Prequalified" welded joints where applicable and by certified welders. No onsite or field welding shall be permitted.
 - 2. All full penetration welds shall be continuously inspected by an independent inspection agency and shall be tested to the requirement of IBC 2015 and local agency additions and amendments.
- G. Powder Coating:
 - 1. Galvanized steel tubing preparation prior to powder coating shall be executed in accordance to solvent cleaning SSPC-SP1. Solvent such as water, mineral spirits, xylol, toluol, which are to be used to remove foreign matter from the surface. A mechanical method prior to solvent cleaning prior to surface preparation shall be executed according to Power Tool Cleaning SSPC-SP3 and utilizing wire brushed abrasive wheels and needle gun, etc.
 - 2. Carbon structural steel tubing preparation prior to powder coating shall be executed in accordance to commercial blast cleaning SSPC-SP6 or NACE #3. A commercial blast cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, mill scale, rust, coating, oxides, corrosion, products and other foreign material.
 - 3. Powder coating shall be sufficiently applied, with a minimum three mils thickness and cured at the recommended temperature to provide proper adhesion and stability to meet salt spray and adhesion tests as defined by the American Society of Testing Materials.
 - 4. Powder used in the powder coat process shall have the following characteristics:
 - a. Specific Gravity: 1.77 +/- 0.05 g/cm³
 - b. Coverage at 1.0 mils: 109sq.ft/lb/mil
 - c. Storage: 80° F
 - d. Interpron 800 HR is a series of high durability TGIC powder coatings designed for exterior exposure. Tested against the most severe specifications, Interpron

800 HR gives significantly improved gloss retention and resistance to color change.

- e. Rust Protection Powder Under Coat Primer will be required on all structures. POWDURA® Epoxy Powder Coating Z.R. Primer shall be applied in accordance with the manufacturers' specifications. Primer should be fused only and then top coated with the selected powder coat to ensure proper intercoat adhesion.

- H. Tension Cable: Steel cable is determined based on calculated engineering loads.
 - 1. For light and medium loads, 1/4" (nominal) galvanized 7 x 19 strand cable to be used.
 - 2. For heavy loads, 3/8" (nominal) galvanized 7 x 19 cable to be used.
- I. Fabric Roof Systems
 - 1. UV shade fabric is made of UV stabilized Shadesure® cloth as manufactured by MultiKnit Ltd and made of a UV stabilized high-density polyethylene mesh. Mesh shall be raschel knitted with monofilament and tape yarn filler to ensure that material will not unravel if cut. Panels to be 10ft. wide.
 - 2. Fabric Properties:
 - a. Life Expectancy: A minimum of 8 years continuous exposure to the sun
 - b. Fading: Minimum fading after 5 years (3 years for red)
 - c. Fabric Mass: 2.43-2.58 oz/sqft (190-200g/sm)
 - d. Fabric Width: 9.8425 (3m)
 - e. Roll Length: 164.04 (50m)
 - f. Roll Dimensions: 62.99"x16.5354" (160 cm x 42 cm)
 - g. Roll Weight: +/- 66 lbs (+/-30 kg)
 - h. Minimum Temperature: -13°F (-25° C)
 - i. Maximum Temperature: +176°F (80° C)
 - 3. Stitching & Thread:
 - a. All sewing threads are to be double stitched.
 - b. Thread shall be GORE Tenara Sewing Thread manufactured from 100% expanded PTFE (Teflon); mildew resistant exterior approved thread. Thread shall hold a 10-year warranty. Thread shall meet or exceed the following:
 - 1) Flexible temperature range
 - 2) Very low shrinkage factor
 - 3) Extremely high strength, durable in outdoor climates
 - 4) Resists flex and abrasion of fabric
 - 5) Unaffected by cleaning agents; acid rain, mildew, salt water and rot resistant, unaffected by most industrial pollutants
 - 6) Treated for prolonged exposure to the sun

2.2 SHIPPING AND HANDLING

- A. All steel surfaces touched by tie down straps are to be padded before final clinching. This can be accomplished by using carpet pads or factory manufactured padding.
- B. All dunnage must be padded before painted products are set in place. Smaller and loose pieces must be padded and totally separate from paint padding.
- C. Unloading: Lift forks to be covered with padding. All dunnage must be padded vertically and horizontally to prevent damage to painted surfaces. When unloading, take care to prevent tools and other hard surface items from making contact.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation of shade structures shall be performed by manufacturer or manufacturer-approved contractor, which shall be bonded and holding a current contractor's license with the State of Texas Contractors State License Board. All installation personnel must have proven experience in the erection of tensioned fabric structures.
- B. The contractor installing the structure shall comply with manufactures instructions for assembly, installation, and erection per approved drawings.
- C. Concrete:
 - 1. Unless noted otherwise for footing and piers by General Contractor's Engineer, concrete specification for footings, piers, slabs, curbs and walkways shall meet a minimum 2,500 psi at 28-day strength.
 - 2. Concrete and foundations are to be inspected by independent 3rd Party Inspection Company on site with 30-day break test to follow in order to provide necessary documentation for permit close out with the City.
 - 3. Concrete work is executed in strict accordance with the latest American Concrete Institute Building Code (ACI 318-99).
 - 4. Slump 4" maximum.
 - 5. Whenever daily ambient temperatures are below 80 degrees Fahrenheit, the contractor may have mix accelerators and hot water added at the batch plant.
 - a. Temperature range between 75-80 degrees, 1% accelerator High Early (non-calcium)
 - b. Temperature range between 70-75 degrees, 2% accelerator High Early (non-calcium)
 - c. Temperature range below 70 degrees, 3% accelerator High Early (non-calcium)
 - 6. The contractor shall not pour any concrete when daily ambient temperature is below 55 degrees Fahrenheit.

Temperature Range	% Accelerator	Type Accelerator
75-80 degrees	1%	High Early (non-calcium)
70-75 degrees	2%	High Early (non-calcium)
Below 70 degrees	3%	High Early (non-calcium)

- D. Foundations:
 - 1. All Anchor Bolts set in new concrete shall be ASTM F-1554 GR 55
 - 2. All Anchor Bolts shall be Hot Dipped Galvanized
 - 3. Pier Footings
Structure 1 - Minimum footing size shall be 24" diameter x 9' depth and placed in accordance with/ and conform to manufacturers engineered specifications and drawings.

END OF SECTION 13 31 23

SECTION 21 00 01 – BASIC FIRE PROTECTION REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic Fire Protection Requirements specifically applicable to Division 21 sections, in addition to Division 1 - General Requirements.

1.02 REFERENCES

- A. All references in Division 21 to codes, standards or other publications shall be the latest edition / version, unless noted otherwise.
- B. International Fire Code
- C. NFPA 13 – Standard for the Installation of Sprinkler Systems.
- D. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
- E. NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- F. NFPA 70 – National Electrical Code.
- G. NFPA 72 – Fire Alarm and Signaling Code.
- H. NFPA 101 – Life Safety Code
- I. NFPA 241 – Standard for Safeguarding Construction, Alteration, and Demolition Operations.
- J. UL – Fire Equipment Directory.
- K. UL 199 – Automatic Sprinklers.

1.03 PLANS

- A. These specifications are accompanied by plans indicating typical layouts, pipe and equipment location, etc. The plans and these specifications are complimentary each to the other and what is called for by one shall be as binding as if called for by both. Should there be a conflict between Drawings and specifications regarding a material shown of work described or detailed then the material of work having the greater value shall be provided.
- B. The plans as prepared are in general diagrammatic. The Contractor shall carefully lay out his work at the site to conform to the architectural, mechanical, electrical and structural conditions to provide grading of piping, to avoid all obstructions and to conform to details of installation as shown on the plans and supplied by the manufacturers of the equipment to be installed, and thereby to provide an integrated satisfactorily operating installation. **The General Contractor must coordinate the work of all trades.** All necessary offsets in piping, fittings, ductwork, etc. required to avoid interferences between piping, equipment, structural and architectural work are not shown but shall be furnished and installed by the contractor without additional expense to the Owner.

- C. This project contains several different type of ceiling finishes, ceiling heights, elevation changes, high volumes, etc. The contractor shall coordinate all pipe routing to keep piping concealed above ceilings wherever possible. Where fire protection piping will be exposed in spaces with no ceilings, the piping shall be routed as high and close to structure as possible. The exact routing and location of exposed piping shall be reviewed by and acceptable to the Architect and Engineer. Exposed elevation change is not acceptable and shall be subject to removal, at the contractor's expense, unless coordinated with the A/E. The contractor shall carefully coordinate pipe routing and sprinkler head locations with all trades.
- D. These specifications and plans accompanying same are intended to cover systems which will not interfere with the design of the building, which will fit into the available spaces, and which will insure complete and satisfactory systems. Each contractor shall, therefore, carefully examine the plans and the building and shall be responsible for the proper fitting of his material and apparatus into the building.
- E. Contractor's attention is directed that all equipment he proposes to furnish shall fit into the spaces allocated for same on the plans. It shall be the Contractor's responsibility to furnish data to evidence that sufficient space can be provided for the installation of proposed equipment and that adequate access will exist for servicing and maintenance of equipment. Should changes become necessary during construction, the contractor shall make such necessary changes at his (the Contractor's) own expense.
- F. Exceptions and inconsistencies in plans and specifications shall be brought to the Architect's attention no later than five (5) days prior to the bid date. Otherwise, the Contractor shall be responsible for any and all changes and additions that may be necessary to accommodate his particular apparatus or equipment.

1.04 CHANGES

- A. Any changes from the plans necessary to make this work conform to the building as it is constructed, to make this work fit the work of other trades or to make this work conform to the rules of city and municipal bodies having jurisdiction shall be made by this contractor at no additional cost to the Owner. However, no changes shall be made from the work described on the plans and these specifications except on written order from the Architect.
- B. If any changes are required other than those mentioned above and the changes involve extra work on the part of the contractor, no charges for this extra work shall be allowed unless authorized in advance of the work by a written order from the Owner and/or Architect stating the charges to be made for the work.
- C. Proposed use of item or equipment other than that specified or indicated may require redesign of structure, partitions, foundations, piping, wiring, or other parts of mechanical, electrical, or architectural layout. Redesign, new drawings, and detailing required shall be prepared and submitted to Architect/Engineer for approval.
- D. Where approved deviation requires different quantity, size and arrangement of wiring, conduit, equipment, etc. from that specified or indicated, provide such items and all other additional equipment required by system at not additional cost to the Owner.

1.05 DELIVERY, STORAGE AND HANDLING

A. Protection:

1. All work, equipment and materials shall be protected at all times to prevent damage or breakage either in transit, storage, installation or testing. All openings shall be closed with caps or plugs during installation.
2. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
3. Damaged equipment or material shall be replaced with new as determined and directed by the Architect or Engineer. In particular, piping insulation which becomes saturated will be rejected and must be removed from the job site. Such repair or replacement shall be at no additional cost to the Owner.
4. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
5. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Owner.
4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.06 SUBSTITUTIONS

- A. The materials, products and equipment described and specified establish a standard of quality, function, dimension and appearance to be met by any proposed substitutions.
- B. Reference Section 01 60 00 – Product Requirements.

1.07 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. The Contractor shall furnish copies of the manufacturer's literature and Drawings describing all proposed equipment and materials indicated in the specifications. The proposed use of the exact equipment and materials specified shall not change this

requirement of including literature describing the proposed equipment. Manufactured items proposed for use, whether specified or proposed for substitution, shall be the current, catalogued product of the manufacturer, and replacement parts shall be available.

- C. Manufacturer's regular catalog sheets will not be acceptable under this requirement unless they indicate completely all of the specification requirements and submittal page labeling criteria stated above. Where drawings cover several sizes or types of construction, they shall clearly indicate the size or type of construction to be used on the project. In cases where several sizes of the same type of equipment are required to be furnished, the submittal shall include a schedule identifying each piece of equipment, complete with all capacity information needed to compare every submitted item with its respective specified item.
- D. Brochures shall contain a certification that the equipment or materials are suitable for conditions shown and specified; that the equipment or materials are believed to be in conformity with the plans and specifications, except as may be specifically described and that approval is recommended. The certification shall be signed by the Contractor. Brochures received not in conformity with these requirements will be returned for required actions. Any deviation from the requirements of the specifications shall be clearly noted and marked for the Engineer's consideration.
- E. Approval of the brochures, or any part of the contents therein, shall not eliminate responsibility for compliance with the plans and specifications, unless specific attention has been called in writing to proposed deviations at the time of transmittal of the brochures and such deviations have been approved, nor shall it eliminate the requirements or the responsibilities, if there are errors of any sort in the data submitted.
- F. Detailed coordination drawings showing proposed fire protection piping layout as well as HVAC ducts and diffusers, HVAC piping, plumbing piping, electrical conduit, light fixtures and other ceiling elements must be submitted for approval prior to proceeding with any installation.
- G. Contractor shall submit a copy of all permits and all inspection results from local authorities as well as result dates and notes from all test performed on the fire protection systems.

1.08 INTERFERENCES AND COOPERATION

- A. The plans are generally diagrammatic and the Contractor shall coordinate the work of the different trades so that interferences between piping, equipment, structural and architectural work will be avoided. Not all offsets in piping, ductwork, etc., are shown. The Contractor shall cooperate with the General Contractor and all other contractors to coordinate their work to avoid interferences and delays and arrange all parts of the work to harmonize in service and appearance with all other parts.
- B. The General Contractor shall coordinate the work of all trades. The various systems to be installed shall follow the normal, common sense priority of systems installation with the highest system to lowest system installation as follows:
 - 1. HVAC ductwork shall be installed up and against building (floor/roof) structural members.

2. Sanitary waste and storm drainage piping system shall begin horizontal routing as high as possible between structural members.
 3. Electrical conduit shall be installed up, and against building structure, running parallel with HVAC ductwork and offsetting up into structural bay (void) or below HVAC ductwork to obtain a change in direction or branch take-off.
 4. Domestic hot and cold water supply and hot water circulating return piping, and medical gas piping shall be installed beside and below the HVAC ductwork and electrical conduit.
 5. Fire sprinkler piping system shall be installed below all other systems and components. The fire sprinkler piping shall not conflict with the installation or removal of ceiling system components or tile. The fire sprinkler system piping layout and installation shall be coordinated by the fire sprinkler contractor and the General Contractor with all other trades performing work in the affected area, to avoid conflict with the installation or removal of any other systems components, or to prevent ready access to valves, equipment of the other trades. Do not install sprinkler piping until ductwork mains are in place.
- C. Provide an overhead coordination submittal per Section 01 30 00. The submittal shall include all structural, plumbing, mechanical, electrical, and fire protection components.

1.09 MATERIALS AND WORKMANSHIP

- A. All materials shall be new, of the quality specified and free of any defects. Manufacturer's names are listed to establish a standard of quality and construction.
- B. The Contractor will be responsible for transportation of his materials to the job and for their storage and protection until the final acceptance of the job.
- C. Contractor shall furnish all necessary scaffolding, tackle, tools and appurtenances of all kinds and all labor required for the safe and expeditious execution of his contract.

1.10 PERMITS AND INSPECTIONS

- A. The Contractor will be responsible for all permits and inspections required by law for the completion of his work. Cost of all permits and inspections shall be paid for by the Contractor. The Contractor shall obtain and pay for all certificates of approval which must be delivered to the Architect before final acceptance of the job. All materials and labor furnished by the Contractor shall be in strict accordance with the rules and requirements of the National Board of Fire Underwriters, state and municipal regulations and other authorities who may have lawful jurisdiction over the work being done. One (1) copy of all permits obtained under this contract and all inspections performed and/or certificates of acceptances, approval or beneficial occupancy received for this work, shall be forwarded to the Engineer.
- B. Each contractor shall be responsible for coordinating their work with the General Contractor and scheduling progress inspections through the General Contractor to allow for the following inspections to be performed without impeding the progress of construction. Generally, the Contractor shall plan for inspections to occur two (2) weeks prior to the scheduled concealment of work in the area of inspection.

1.11 EXAMINATION OF SITE

- A. All Contractors submitting proposals for this work shall first examine the site and all conditions thereon and therein. All proposals shall take into consideration conditions as may affect the work under this contract. They shall satisfy themselves as to existing grades and the actual formation, and soil conditions.
- B. Contractors shall verify all service locations, depths, sizes, etc. No information given on the plans shall relieve the Contractor of this responsibility.
- C. Before starting work, the Contractor shall verify all associated existing systems, pipe sizes, locations, and dimensions so that the new systems can be properly connected as indicated on the documents.

1.12 QUALITY ASSURANCE

- A. Perform Work in accordance with the codes listed on the drawings, the local authority having jurisdiction, the Owner's Insurance carrier and the Architect/Engineer. As the minimum standard for the level of quality, in all cases the greater quantity or better quality shall be the first consideration for the basis of an acceptable product or process. The local authority having jurisdiction, the Architect and the Engineer shall have the final authority on the approval and/or use of any product or process specified or submitted for substitution. The greater quality and/or value specified herein for the system(s) and various components and installation procedures shall take precedence over the minimum requirements of the herein before mentioned codes or that of NFPA 13, NFPA 14 or NFPA 24 in all instances.
- B. Equipment and Components: Bear UL and FM label or marking.
- C. Welding Materials and Procedures: Perform to ASME Code.
- D. Valves: Bear UL/FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- E. Piping: All piping installed on this project shall bear the complete ASTM and Manufacturer's marking. Labeling and identification requirements as required by ASTM. All installed piping 3'-0" or greater in length shall be readily identifiable per ASTM labeling criteria. Piping not bearing this identification upon installation shall be removed and replaced by the correctly labeled piping. Piping shall not be re-stenciled after it is installed, to meet this requirement.

1.13 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers and equipment. Locate piping, sleeves, inserts, hangers and equipment clear of windows, doors, openings, light outlets, ductwork and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items and valves. All gages and indicators shall be clearly visible by personnel

standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.

- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Minor Piping: Generally, small diameter pipe runs from drips and drains and other services are not shown but must be provided.
- F. Install gages, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- G. Work in Existing Building: Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Owner. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to Cutting and Patching article in Part 3 of this section.

1.14 UNIONS

- A. No unions are to be placed in any pipe in a location which will be concealed or inaccessible after completion of the building unless furnished with an access panel either as shown on the Drawings or as specified herein. Unions must be installed on each side of all pieces of equipment such as heating units, pumps, etc., so that such equipment may be readily disconnected.

1.15 TEMPORARY PIPING AND EQUIPMENT

- A. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.
- B. When construction is complete, temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs in potable water systems will not be allowed. Provide necessary blind flanges and caps to seal open piping remaining in service.

1.16 FIRE ALARM INTERFACE

- A. Ensure that all required fire protection system alarm devices are installed and connected as required to the fire alarm system; including but not limited to: flow switches, tamper switches and alarm notifications.

1.17 UTILITIES

- A. The Contractor shall arrange and pay for any necessary revisions to existing utility services, including meter deposits and connection fees to all serving utility companies and shall install utilities, where applicable.

1.18 INDOOR AIR QUALITY CONTROL:

- A. All Adhesives, sealants, paints, coatings applied within the weatherproofed interior of the building shall comply with applicable VOC thresholds of SCAQMD 1113 and 1168.

PART 2 PRODUCTS

2.01 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 - 1. All components of an assembled unit need not be products of same manufacturer.
 - 2. Constituent parts that are alike shall be products of a single manufacturer.
 - 3. Components shall be compatible with each other and with the total assembly for intended service.
 - 4. Contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.02 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.03 ESCUTCHEONS AND PLATES

- A. Where pipes pass through ceilings or walls in finished spaces, install sectional plates or escutcheons to cover the annular opening between pipe and sleeve. Solid plates with set screws shall be used where the sectional plates will not stay in place or are not available in the required size, or where other individual specification section(s) require one piece or greater quality escutcheons or plates.

- B. The annulus between pipe and walls or floors, shall be filled with Sonolastic NP unless fire wall or barrier then the approved UL listed fire assembly shall be used.
- C. Inside diameter of escutcheons shall fit around insulation and around pipe when not insulated; outside diameter shall cover sleeve. Secure escutcheons or plates to pipe or sleeve but not to insulation. All escutcheons shall be triple nickel-chromium plated brass, or Type 316L stainless steel.

2.04 INSULATION

- A. All insulation materials used inside the building on this project, including finishes and adhesives on the exterior surfaces of ducts, pipes and equipment shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255 as required by NFPA 90A, unless noted otherwise acceptable.

2.05 ASBESTOS

- A. Materials containing asbestos are not permitted.
- B. If any asbestos-containing material is discovered or suspected, the contractor shall immediately cease any and all work in that area. Cover the exposed material in plastic containment without disturbing the exposed material and notify the Architect and the Owner's representative.
- C. Certify in writing that neither the Contractor nor any of Contractor's subcontractors or suppliers will supply any materials that contain any asbestos in any form for this Project.

PART 3 EXECUTION

3.01 ACCESS PANELS

- A. All valves, drains, gauges, etc., must be accessible. The Contractor shall, wherever required to service his installation, coordinate size and location of access panels with General Contractor. Refer to Section 08 31 13 – Access Doors and Frames.

3.02 FIRESTOPPING

- A. Firestopping: Unused slots, sleeves and other penetrations in floors, walls or other general construction shall be closed and sealed with an approved firestopping material.
 - 1. Reference Section 07 84 00 – Firestopping for appropriate firestopping material required for each wall rating and penetration size and type.
 - 2. Floor slots and openings shall be closed with 16-gauge galvanized steel sheet supported on 1-inch by 1-inch by 1/8-inch structural angle drilled or supported with powder-driven studs into the building structure. Firestop with a layer of silicone elastomer not less than 1-inch thick which completely fills the opening. The top surface of the silicone elastomer shall be approximately 1 inch below the finished floor slab.
 - 3. Openings in walls shall be closed with 16-gauge galvanized steel sheet securely

attached at the midpoint of the wall thickness and firestopped on both sides of the steel sheet with not less than 1/8-inch thick layer of non-sagging silicone elastomer to fully cover the opening.

4. Single or multiple pipes passing through walls and floors shall have the annular space between pipes or between pipes and structure filled with silicone elastomer to provide a 3-hour rated firestop for floors and walls.
- B. The annulus between exposed pipe and walls or floors, in finished spaces shall be refilled, sealed and painted to match adjacent surfaces.

3.03 PAINTING

- A. Paint all exposed fire sprinkler pipe. Paint color shall be submitted and acceptable to the Architect and Engineer. Where the color is other than Red; then the pipe shall also be labeled.
- B. Surfaces to be painted and types of paint shall be as specified in the Architectural specifications. Refer to Section 09 90 00.
- C. All surfaces to be painted shall be thoroughly cleaned, all rust scraped off and all oil and grease removed before any paint is applied.
- D. Under no conditions shall paint be applied to sprinkler heads, escutcheons, or covers. If paint is so applied, replacement of the affected parts shall be required.
- E. Finishing paint coats shall not be applied until all the plastering or other structural building work is completed. Cloths shall be spread where necessary to prevent drops of paint, oil, etc. from defacing walls, floors, etc., and the Contractor shall be held responsible for all damage by neglect of such precautions. The finished conditions of the painting shall be subject to the approval of the Architect, who may require retouching or repainting of surfaces not properly finished.

3.04 CLOSE OUT DOCUMENTATION AND TESTING REPORTS

- A. Contractor shall provide Project Record Documents, Operation and Maintenance data and all product warranty data as specified in Section 01 70 00.
- B. Contractor shall provide copies of all fire protection system tests and certification reports for inclusion in project close out documents. Reports shall include, but shall not be limited to, the following:
1. Acceptance testing for various fire protection systems, as required by appropriate NFPA standard.
 2. Contractor's Material and Test Certificates.
 3. Final approval documentation from local Fire Department.
 4. Backflow prevention assembly certifications.
- C. Contractor shall provide As-Built Fire Protection Drawings, as hard copies and/or electronic format as required by Owner.

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END OF SECTION

SECTION 21 05 00 – COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Pipe, fittings and valves for fire suppression systems.
- B. Fire department connections.
- C. Piping specialties for fire suppression systems

1.02 RELATED SECTIONS

- A. Section 09 90 00 – Painting: Preparation and painting of fire protection piping systems.
- B. Section 21 00 01 - Basic Fire protection Requirements
- C. Section 21 05 53 – Fire Protection Identification.
- D. Section 21 13 13 – Wet Pipe Sprinkler Systems.
- E. Section 26 05 03 – Equipment Wiring Systems.
- F. Section 28 31 00 – Fire Detection and Alarm.

1.03 REFERENCES

- A. ASME Boiler and Pressure Vessel Code Section IX – Welding and Brazing Qualifications.
- B. ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
- C. ASME B16.3 – Malleable Iron Threaded Fittings, Class 150 and 300.
- D. ASME B16.4 – Cast Iron Threaded Fittings, Class 125 and 250.
- E. ASME B16.5 – Pipe Flanges and Flanged Fittings.
- F. ASME B16.9 – Factory-made Wrought Steel Buttwelding Fittings.
- G. ASME B16.11 – Forged Steel Fittings, Socket-welding and Threaded.
- H. ASME B16.15 – Cast Bronze Threaded Fittings
- I. ASME B16.25 – Buttwelding Ends.
- J. ASME B36.10 – Welded and Seamless Wrought Steel Pipe.
- K. ASTM A135 – Electric-Resistance-Welded Steel Pipe.
- L. ASTM A47 – Malleable Iron Castings.
- M. ASTM A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- N. ASTM A234 – Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and

Elevated Temperatures.

- O. ASTM A395 – Standard Specification for Ferritic Ductile Iron Pressure-Rated Castings.
- P. ASTM A795 – Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
- Q. ASTM D2000 – Standard Classification System for Rubber Products.
- R. AWWA C110 – Ductile-Iron and Gray-Iron Fittings.
- S. AWWA C111 – Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- T. AWWA C151 – Ductile-Iron Pipe, Centrifugally Cast.
- U. AWWA C550 – Protective Interior coatings for Valves and Hydrants.
- V. AWWA C900 – Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings.
- W. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
- X. AWS A5.8 – Specification for Filler Metals for Brazing and Braze Welding.
- Y. AWS D10.9 – Specifications for Qualification of Welding Procedures and Welders for Piping and Tubing.
- Z. NFPA 13 – Standard for the Installation of Sprinkler Systems.
- AA. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
- BB. NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
- CC. NFPA 70 – National Electric Code
- DD. NFPA 72 – Fire Alarm and Signaling Code.
- EE. NFPA 101 – Life Safety Code.
- FF. NFPA 241 – Standard for Safeguarding Construction, Alteration, and Demolition Operations.
- GG. UL – Fire Equipment Directory.
- HH. UL 262 – Gate Valves for Fire-Protection Service.
- II. UL 312 – Check Valves for Fire-Protection Service.
- JJ. UL 405 – Fire Department Connections.

1.04 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 01 33 00 and Section 21 00 01.

- B. General: All new applications, all rework applications and all modifications to existing systems shall be submitted for approval as described herein.
- C. At start of project, perform current fire flow tests or secure current water pressure/flow capacity data from water utility. Do not rely on previous data or reports unless such were prepared with the site/city utilities being unchanged from current conditions and unless data was obtained within 6 months prior to system design.
- D. Product Data: Provide data on sprinkler heads, piping materials, joining methods, supports, valves, flow switches, tamper switches and all other components and accessories intended to be installed. Include manufacturers' catalog information, Code and Standards compliance, performance ratings, rough-in details, weights, finishes, support and connection requirements.
- E. Coordination Drawings: Submit piping and sprinkler head Layout Drawings that have been fully coordinated with other disciplines to avoid space conflicts. Prepare these Coordination Drawings prior to submittal of fire suppression Drawings for Fire Department approval.
- F. Shop Drawings:
 - 1. Submit detailed and accurate Shop Drawings electronically of entire systems prior to fabrication. Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate system controls, hydraulic reference points, detailed pipe layout, valves, hangers and supports, components and accessories.
 - 2. Hydraulic calculations: Submit flow test results and comprehensive hydraulic data sheets complying with NFPA 13.
 - 3. Where expanding existing systems, the submitted design drawings shall show a sufficient amount of the existing system as required, the minimum shall show back to cross main or feed main to clearly identifying how the new work connects to the existing system.
- G. Design Data: Submit Shop Drawings and design calculations signed and sealed by professional engineer, licensed by the State of Texas or a Responsible Managing Employee (RME), as defined in the Texas Insurance Code, Article 5.43-3§1C10, licensed by the State of Texas Fire Marshal Office for the fire protection system installed.
- H. Design (e.g. hydraulic calculations) shall include a minimum "safety factor" of 10% of the hydrant flow test static pressure or 10 psig (whichever is greater) to account for future variations in water supply pressure, deterioration of piping system and future renovations to system. Hydraulic calculations shall show inclusion of this "safety factor."
- I. Fire Suppression Submittals:
 - 1. Submit Drawings for approval by local Fire Department and Owner's insurance carrier after acceptance of Coordination Drawings by Owner and Engineer.
 - 2. Submit Drawings and calculations approved by local Fire Department for final approval by Owner and Engineer.

1.05 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01 70 00 – Execution and Closeout Requirements.
- B. Project Record Documents: Record actual locations of sprinklers and all deviations of piping from approved shop drawings. Indicate sizes and types of sprinkler heads, all valve, drain and test locations and all system equipment or other components. Provide electronic copies of all system record documents and final hydraulic calculations.
- C. System Acceptance Forms: Provide appropriate Contractor's Material and Test Certificate(s), completed and signed, as required by Chapter 25 of NFPA 13.
- D. Provide certification of compliance from local authority having jurisdiction indicating approval of system acceptance test(s).
- E. System Certification: For any project subject to the Hospital Licensing Rules of the Texas State Department of Health Services, the Contractor shall provide a copy of a letter or certification from a professional engineer (P.E.) licensed in the State of Texas and experienced in fire sprinkler system installations, indicating that the fire sprinkler working plans, hydraulic calculations, system testing and field inspection of the new or modified sprinkler system is in compliance with the requirements of NFPA 13, Standard for the Installation of Sprinkler Systems.
- F. Provide test certifications form any Backflow Prevention Assemblies.
- G. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot. Provide a preventative maintenance schedule for all applicable equipment and systems. Also include a copy of NFPA 25 for the Owner's reference.
 - 1. This Project and the fulfillment of the Contractor's responsibilities will not be considered for "Substantial Completion" until the Owner's Operation and Maintenance Manuals (and, if required, the corrected copies) have been submitted to and approved by the Engineer; and, in turn submitted to the Owner; and, the Owner's facilities personnel have received the required instructional period on the operation and maintenance of the installed systems and equipment.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
- I. Provide a final acceptance letter from the Owner's insurance provider.

1.06 QUALITY ASSURANCE

- A. Sprinkler and Standpipe Systems: Perform work to the International Building Code, NFPA 13 and 14 as modified herein, the local authority having jurisdiction, and the Architect/Engineer, and the requirements of the owner's insurance carrier. The greater quality and/or value specified herein for the system(s) and various components and installation procedures shall take precedence over the minimum requirements of NFPA, in all instances.
- B. Sprinkler Shop Drawings and hydraulic calculations are to be sealed by a Professional Engineer, knowledgeable in fire protection engineering or a Responsible Managing Employee (RME) licensed by the State of Texas Fire Marshal Office, before submitting

for review.

- C. Welding Materials and Procedures: Perform to ASME Code.
- D. Valves: Bear UL/FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- E. Piping: All piping installed on this project shall bear the complete ASTM and manufacturer marking, labeling and identification requirements as required by ASTM. All installed piping 3'-0" or greater in length shall be readily identifiable per ASTM labeling criteria. Piping not bearing this identification upon installation shall be removed and replaced by the correctly labeled piping. Piping shall not be re-stenciled after it is installed to meet these criteria. Maintain one copy of each document on site.
- F. The system shall conform to applicable requirements of the Texas Administrative Code Title 28, Chapter 34.

1.07 REGULATORY REQUIREMENTS

- A. Sprinkler Systems: Conform work to NFPA 13.
- B. Service Mains: Conform to NFPA 24.
- C. Installation, identification and Testing: Conform to NFPA 25.
- D. FM Global standards and guidelines.
- E. Welding Materials and Procedures: Conform to ASME Code AWS D10.9.
- F. Valves: Bear UL FM label or marking. Provide manufacturer's name and pressure rating marked on valve body. UL or FM approved for fire protection service.
- G. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.
- H. Texas Administrative Code, Title 28, Chapter 34.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Deliver and store valves in shipping containers, with labeling in place. Provide temporary protective coating on cast iron and steel valves. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- C. Piping and piping systems shall not be allowed to be exposed to exterior weather or elements. Piping, fittings and valves stored outside shall be covered at all times and shall be stored on pallets or rack systems, above ground. Piping, fittings and valves stored inside shall be stored on pallets or racks and shall not be allowed to be strewn around the construction area. Cleanliness of the work area and safety of the construction personnel shall be the first consideration.

1.09 EXTRA MATERIALS

- A. Section 01 70 00 – Contract Closeout.

- B. Provide one valve stem packing for each size and type of valve installed.

PART 2 PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. All piping, materials and equipment used in the installation of sprinkler and standpipe systems shall be new and listed as approved by the Underwriters' Laboratories, Inc., List of Inspected Fire Protection Equipment and Materials and the Factory Mutual Testing Laboratories List of Approved Equipment, Fire Protection Devices and Devices Involving Fire Hazard and shall be the latest design of the manufacturer.
- C. Pressure ratings of pipe, fittings, valves, gauges and all other water carrying appurtenances shall be suitable for the designed system pressures in which they are installed.
- D. The installing Contractor shall identify piping, fire department connections, valves and hydraulic design information in accordance with applicable NFPA Standards.

2.02 BELOW GRADE PIPING

- A. General: All materials shall comply with applicable NFPA, ASTM, AWWA, UL and FM standards. All valves shall be UL listed and FM approved for the fire protection service.
- B. Below-grade piping shall be one of the following:
 - 1. AWWA C151 cement mortar lined ductile iron water pipe with restrained push-on joints. All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4-mil (minimum) cross laminated high-density polyethylene conforming to AWWA C-105.
 - a. Push-on joints shall be in accordance with ANSI/ AWWA C111/A21.11 "Rubber-Gasket Joints for Ductile-Iron Pipe and Fittings." Restrained joint fittings and the restraining components shall be ductile iron in accordance with applicable requirements of ANSI/AWWA C110/A21.10 and/or C153/A21.53 with the exception of the manufacturer's proprietary design dimensions. Push-on joints for such fittings shall be in accordance with ANSI/AWWA C111/A21.11. Restrained joint pipe and fittings shall be U.S. Pipe's TR FLEX Pipe and Fittings or approved equal. Restraint of field cut pipe shall be provided with U.S. Pipe's TR FLEX GRIPPER Ring, TR FLEX Pipe field weldments or approved equal.
 - b. Restrained push-on joints for pipe and fittings shall be designed for a water working pressure of 350 psi for sizes 4 inches through 24 inches. For fire protection service, 4-inch through 12-inch pipe and fittings are listed by Underwriters Laboratories for 350 psi and are approved by Factory Mutual for 250 psi.
 - c. Cement mortar lining and seal coating for pipe and fittings, where applicable, shall be in accordance with ANSI/AWWA C104/A21.4.
 - d. Asphaltic outside coating shall be in accordance with ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/ A21.53 for fittings. or

2. ANSI/AWWA C900-07, FM 1612 DR 18 PVC with bell and spigot type joints with elastomeric gaskets and metallic restraining casings and rings, 235 PSI pressure class. J.M. Eagle "Eagle Loc 900" or approved equal.
- C. Provide approved transition couplings/fittings as required from one piping material to another.
- D. Building service riser: Riser shall be composed of a single extended 90-degree fitting of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a flanged connection on the inlet (building) side and a CIPS coupler on the inlet (underground) side. Riser shall be equivalent to Ames Fire & Waterworks Series IBR In-Building Riser.

2.03 ABOVE-GROUND PIPING

- A. Steel Pipe for Wet-Pipe Systems: Schedule 40 black steel pipe meeting ASTM A53 (Grade B, Type S or E); ASTM A135; or ASTM A795. All pipe shall be either seamless or electric resistance welded – furnace welded pipe will not be allowed. All pipe shall be UL listed or FM approved for fire protection service and the interior surface shall be coated to reduce microbiologically influenced corrosion (MIC). At contractor's option, piping larger than 2 inches may be Schedule 10 black steel pipe, meeting all of the above requirements.
 1. Steel Fittings: ASME B16.9, wrought steel, buttwelded; ASME B16.25, buttweld ends; ASTM A234, wrought carbon steel and alloy steel; ASME B16.5, steel flanges and fittings; ASME B16.11, forged steel socket welded and threaded.
 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings; ASME B16.4, threaded fittings.
 3. Malleable Iron Fittings: ASME B16.3, threaded fittings ASTM A47.
 4. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers.
 5. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.04 PIPE HANGERS AND SUPPORTS

- A. Conform to NFPA 13.
- B. Fire protection piping shall be substantially supported from the building structure as required by NFPA 13.
- C. Fire protection piping shall be supported independently of all other systems.
- D. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
- E. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.
- F. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

- G. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- H. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- I. Vertical Support: Steel riser clamp or Angle ring.
- J. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- K. Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.05 VALVES

- A. Similar types of valves shall be the product of one manufacturer; i.e., all butterfly valves shall be of the same manufacturer, all ball valves shall be of the same manufacturer, etc.
- B. All valves used to control the flow of water to and within standpipe and sprinkler systems shall be listed indicating type complete with electric supervisory switches. Coordinate wiring with the electrical Contractor.

2.06 GATE VALVES

- A. Up to and Including 2 Inches: UL listed, FM approved, complying with AWWA C550 and NSF 61 approved, bronze body, bronze trim, rising stem, handwheel, inside screw, double wedge or disc, threaded ends.
- B. Over 2 Inches: UL listed, FM approved, complying with AWWA C550 and NSF 61 approved, iron body, bronze trim, non-rising stem, handwheel, double wedge, flanged, grooved or mechanical joint ends.
- C. Underground application: UL listed, FM approved, 250 PSI WWP flanged iron body non-rising stem gate valve with square operating nut. bolted bonnet and resilient wedge. The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior, complying with AWWA C550 and be NSF 61 approved.
 - 1. Provide solid bar, carbon steel, valve stem extension. Provide ductile iron bonnet box and cover; bonnet box extension and 316 S.S. centering ring

2.07 GLOBE OR ANGLE VALVES

- A. Up to 2 Inches: UL listed and FM approved Bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, screwed ends, with back seating capacity repackable under pressure.
- B. Over 2 Inches: UL listed, FM approved Iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

2.08 BALL VALVES

- A. Up to and Including 2 Inches: UL listed, FM approved Iron Bronze three-piece body, stainless steel ball, Teflon seats and stuffing box ring, with integral, factory-mounted tamper switch, threaded ends with union.

- B. Over 2 Inches: UL listed, FM approved cast iron or ductile iron body, stainless steel ball, Teflon seat and stuffing box seals, with integral factory-mounted tamper switch, and threaded or grooved ends.

2.09 BUTTERFLY VALVES

- A. Over 2 Inches: Ductile iron body conforming to ASTM A395 with polyamide coating, ductile iron disc, UL listed, FM approved with EPDM encapsulated rubber seal conforming to ASTM D2000, Type 416 stainless steel stem and gear operator with handwheel and indicator flag. Valves shall be furnished with integral supervisory switch rated for 1/2 amp at 120-volt DC and 5 amps at 120-volt AC.

2.10 CHECK VALVES

- A. Manufacturers: UL listed, FM approved.
- B. Up to and Including 2 Inches: Bronze swing disc, screwed ends.
- C. Over 2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends.

2.11 DRAIN VALVES

- A. Manufacturers: UL listed, FM approved.
- B. Bronze compression stop with hose thread nipple and cap.
- C. Brass ball valve with cap and chain, 3/4-inch hose thread.

2.12 POST INDICATOR AND VALVE

- A. Valve shall be UL listed, FM approved, 250 PSI WWP flanged iron body non-rising stem gate valve with indicator post pattern, bolted bonnet and resilient wedge. The body and bonnet shall be coated with fusion bonded epoxy both interior and exterior, complying with AWWA C550 and be NSF 61 approved.
- B. Post Indicator: UL listed, FM approved, vertical type, cast iron body with operating wrench, extension rod, view windows (for "OPEN" and "SHUT" signage), and adjustable cast iron barrel of length required for depth of burial of valve.
- C. Wall Post Indicator: UL listed, FM approved, horizontal type, cast iron body with hand wheel, view windows (for "OPEN" and "SHUT" signage) and 12" wide wall flange.

2.13 BACKFLOW PREVENTERS

- A. Provide one of the following double check valve backflow prevention assemblies on the fire water service entry, unless local municipality requires a reduced pressure type backflow preventer. Double check valve assembly shall be UL listed, FM approved and ASSE 1015 listed.
- B. Where installed inside building, backflow prevention assembly shall be equal to Watts Series 757 or 757N with two independent check modules within a single type 304 schedule 40 stainless steel housing with four test cocks and grooved butterfly shutoff valves with integral tamper switches. Assembly shall be available for either horizontal or vertical installation.

- C. Where installed outside building or where required by AHJ to monitor unauthorized use of water, provide double check detector assembly equal to Watts Series 757DCDA or 757NDCDA with two independent check modules within a single type 304 schedule 40 stainless steel housing with four test cocks and grooved butterfly shutoff valves with integral tamper switches. The assembly shall also include a bypass line with meter, double check backflow assembly and required test cocks. The overall assembly shall be available for either horizontal or vertical installation.

2.14 FIRE DEPARTMENT CONNECTIONS

- A. Provide a fire department connection as required by NFPA and the local Fire Department, at the location indicated on the Drawings.
- B. Each fire department connection shall consist of 2-1/2-inch inlets with clappers compatible with equipment utilized by the local Fire Department and equipped with UL listed Knox caps with swivel guards (Knox model 3140 or approved equal, keyed for the local Fire Department). Provide adequate number of inlets to meet sprinkler and/or standpipe system design flow, based on a maximum of 250 GPM per inlet connection.
- C. Wall-mounted Fire Department Connections shall be flush mounted type with ductile iron body and polished brass plate and snoots with pin lug hose thread inlets, equal to Potter-Roemer 5100-5400 Series.
- D. Free standing Fire Department Connections shall have either a cast brass or red polyester coated ductile iron body, with 18" long polished brass cover sleeve and cast brass identification base plate, equal to Potter-Roemer 5761-5792 Series.
- E. Each fire department connection shall be labeled as required by the local Fire Department with raised letters reading "AUTOMATIC SPRINKLER" or "STANDPIPE".
- F. Each fire department connection shall be mounted not be less than 2 feet and not more than 3 feet 6 inches in elevation, measured from the ground level to the centerline of the inlets.
- G. Provide signage as required by NFPA 13 and NFPA 14, and any additional signage specifically required by the local fire department.

2.15 OUTSIDE ALARM BELL

- A. UL listed and FM approved vibrating type electric bell for fire signaling to receive signal from Fire Alarm System with 120-volt single phase power requirement, 10" size, for outdoor use, red powder coating with weatherproof back box, 94 dB at 10 feet.

2.16 WATER FLOW ALARM SWITCH

- A. Provide, where indicated on the drawings and where required by NFPA 13., Provide field adjustable vane type waterflow switch UL listed and FM approved, Flow switch shall be provided with delay, adjustable up to 90 seconds. See Division 28 for electrical signal connection by others to these flow switches.

2.17 SPRINKLER SYSTEM INSPECTOR'S Test Assembly

- A. NFPA 13 compliant UL Listed and FM approved sprinkler system inspector's test assembly, consisting of sight glass, tamper resistant test orifice, test and drain ball valve, rated for 300 psi.

2.18 SUPERVISORY SWITCHES

- A. UL Listed and FM approved unit for monitoring the open position of fire protection valves, red in color, tamper proof cover, two double throw double pole micro-switches, NEMA 3R enclosure, Coordinate with Division 28 for power requirements.
- B. UL Listed and FM approved supervisory actuated low/high pressure switch for low differential dry and preaction valves, designed to detect an increase and/or decrease from normal system pressure in automatic fire sprinkler systems. Unit shall consist of two factory set switches. The low switch is set to activate at approximately 10 psi on a decrease in pressure, and the high switch is set to activate at approximately 20 psi on an increase in pressure. Unit shall have a die-cast cover with textured red powder coat finish, NEMA 4X enclosure, SPDT switch contacts. Coordinate with Division 28 for power requirements.

2.19 PRESSURE SWITCHES

- A. UL Listed and FM approved for use on fire protection systems, pressure type flow switch, activated by any flow of water equal to or in excess of the discharge of one sprinkler head, bellows activated, maximum service pressure rating of 300 psi, adjustable range of 4-20 psi, (2) SPDT contacts, 24 VDC power requirement, 1/2" male NPT, NEMA 4 rating,

2.20 PRESSURE GAUGES

- A. UL Listed and FM approved for use on fire protection systems, 0-300 psi pressure range, phosphor bronze bourdon tube, polycarbonate one-piece ring and crystal, 3-1/2" dial, 1/4" brass connection.

PART 3 EXECUTION

3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Systems shall be flushed until the system is clean of any foreign matter.

3.02 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems; NFPA 14 for standpipe and hose systems; and NFPA 24 for service mains.
- B. Route piping in orderly manner, plumb and parallel to building structure and concealed above ceilings where possible. Locate concealed valves, switches and alarm connections in accessible location, and coordinate size and location of access panels/doors with General Contractor.
- C. Install piping to conserve building space, to not interfere with use of space and other work. Coordinate location of sprinkler piping with access requirements of above ceiling equipment (i.e. mechanical VAV boxes, fan coils, etc.).
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipes passing through partitions, walls and floors.

- F. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.
- G. Pipe Hangers and Supports:
 - 1. Install in accordance with NFPA 13 and NFPA 14.
 - 2. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Provide copper-plated hangers and supports for copper piping, sheet lead packing between hanger or support and piping.
 - 8. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts and suspended ceiling spaces are not considered exposed.
- H. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- I. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.
- J. Do not penetrate building structural members unless indicated otherwise on Contract Drawings.
- K. Provide steel sleeves when penetrating footings, floors and walls.
- L. Penetrations through fire rated walls, floors and partitions shall be sealed to provide a U.L. rating equal to or greater than the wall, floor or partition
- M. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union and couplings for servicing are consistently provided.
- N. Die-cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- O. Provide gate or ball valves for shut-off or isolating service.
- P. Provide UL listed caps for concealed sprinkler heads to match architectural and interior ceiling finishes.

- Q. Provide drain valves at main shut-off valves, low points of piping and apparatus. Extend drain to floor sink/floor drain.
- R. Install valves with stems upright, not inverted. All valves shall be located such that the removal of their bonnets is possible. Valves placed in horizontal lines shall be installed with their valve stems inclined at an angle of a minimum of 30 degrees above the horizontal position. Valves shall be installed as nearly as possible to the locations indicated in the Construction Drawings. Any change in valve location must be so indicated on the Record Drawings. Remove protective coatings after installation.
- S. Heat generated by welding or soldering procedures shall not be transmitted to valves, groove couplings, or any other components installed within the piping system that may be damaged due to high temperatures. Contractor shall take all precautions necessary and allow heated piping to cool to ambient temperature before attachment.
- T. All screw joints shall be made with taper threads properly cut. Joints shall be made tight with Teflon tape or non-toxic joint compound applied to the pipe threads only and not to fittings. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Before installing pipe that has been cut and threaded, the lengths of pipe shall be upended and hammered to remove all shavings and foreign material.
- U. Inspector's test valves shall be installed for each sprinkler control valve assembly.
- V. Do not route piping in the following rooms with the exceptions of solely supplying sprinkler coverage in the area and a sidewall sprinkler head is not practical.
 - 1. IT Computer rooms (i.e. IDF, MDF, Data Rooms)
 - 2. Electrical Rooms.
- W. Do not route sprinkler piping directly over Electrical equipment (i.e. electrical panels, Substations, switchboards, motor control centers, emergency generators, bus duct, transformer).
- X. Paint all exposed sprinkler piping as specified in Section 21 05 00.

3.03 INSTALLATION OF FIRE DEPARTMENT CONNECTIONS

- A. Installation of Fire Department Connections shall all requirements of NFPA and of the local Fire Department.
- B. Fire department connections shall be located not less than 18 inches nor more than 48 inches above the level of adjoining ground sidewalk or grade surface.
- C. Fire department connections shall be located within 100 feet of the nearest fire hydrant unless otherwise approved by the local fire department.
- D. Each fire department connection shall be designated by a sign reading "STANDPIPE" or "AUTOSPKR" or both depending on system served. For manual standpipe systems, signage shall also indicate the pressure required to deliver system demand and whether the standpipe is wet or dry.
- E. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent fire department connectors to allow full swing of fire department wrench handle

and so that hose lines can be attached to inlets without interference from nearby objects.

3.04 INSTALLATION OF BACKFLOW PREVENTION DEVICES

- A. Backflow prevention devices and assemblies shall be installed in compliance with American Water Works Association Manual M-14 "Backflow Prevention," and the following:
1. Devices and assemblies shall be located as shown on plans.
 2. The highest part of any device or assembly shall not be installed over 5 feet above the finish floor. There shall be a minimum of 12 inches clearance above the device/assembly.
 3. The lowest part of any backflow preventer assembly shall be installed a minimum of 12 inches above finish floor.
 4. The service side of any device/assembly shall have a minimum clearance of 24 inches from the outermost dimension.
 5. The non-service side of a backflow assembly shall have a minimum clearance of 4 inches from the outermost dimension.
 6. All backflow and/or backsiphonage assemblies/devices shall be tested in accordance with the rules and regulations of Texas Commission on Environmental Quality and the utility supplying the domestic water before substantial completion inspection is requested.
 7. Final reports shall be submitted to local code/inspection authorities and to A/E and utility prior to scheduling Substantial Completion reviews by the A/E.
 8. Persons performing the test on backflow prevention assemblies/devices shall meet the following requirements:
 - a. Licensed by the Texas Commission on Environmental Quality as a Backflow Prevention Assembly Technician, and
 - b. If required by the utility supplying the water, registered with the utility for testing backflow preventer assemblies.
 - c. Testing of backflow preventer assemblies serving fire protection systems shall be performed by a person or organization with a current certificate of registration from the State Fire Marshal as an independent fire protection sprinkler contractor (Registered Firm) under the direct supervision of a licensed Responsible Managing Employee (RME) as defined by Texas Insurance Code (TIC), Chapter 6003 (formerly Article 5.43-3), Fire Protection Sprinkler System Service and Installation and the Texas Administrative Code Title 28, Chapter 34, Subchapter G – Fire Sprinkler Rules.

3.05 TESTING

- A. Each system installed under this contract shall be cleaned and tested to appropriate NFPA Standards for each particular application.
- B. Refer to appropriate sprinkler system and/or standpipe system specification section for additional system acceptance and testing requirements.

- C. Testing shall also include any additional requirements from the authority having jurisdiction and the Owner's insurance underwriter.
- D. Coordinate system testing with Fire alarm contractor and general contractor.

END OF SECTION

SECTION 21 05 53 – IDENTIFICATION FOR FIRE PROTECTION PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Equipment markers.
2. Valve tags.
3. Valve schedules.
4. Pipe markers.
5. Ceiling tacks.
6. Signs.
7. Detectable Underground Warning Tape.

B. Related Sections:

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 – Scheme for the Identification of Piping Systems.

B. American National Standards Institute:

1. ANSI Z535.1 – Safety Color Standard.
2. ANSI Z535.2 – Environmental and Facility Safety Signs.

C. National Fire Protection Association:

1. NFPA 13.
2. NFPA 20

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures:** Submittal procedures.
- B. Product Data:** Submit manufacturer's catalog literature for each product required.
- C. Shop Drawings:** Submit list of wording, symbols, letter size, and color coding for mechanical identification. Submit a valve chart and schedule, including valve tag number, location, function and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions:** Indicate installation instructions, special procedures, and installation.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.05 QUALITY ASSURANCE

- A. Conform to ASME A13.1 and ANSI Z535.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ASME A13.1 for length of field and letter height for pipe markers.
- C. Conform to ANSI Z535.1 and ANSI Z535.2 for emergency operating information and warning signs.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years of experience.

PART 2 PRODUCTS

2.01 PIPE MARKERS

- A. General: Conform to ASME A13.1 for background and letter colors, length of color field and letter height.
- B. Self-Adhesive Pipe Markers: Flexible, indoor/outdoor grade vinyl with factory-applied pressure-sensitive adhesive. Provide with minimum 1-1/2 inch wide banding tape.
- C. Mechanically Applied Pipe Markers:
 - 1. For pipes with an overall diameter up to 6 inches, including insulation, provide semi-rigid plastic wrap around pipe marker that extends 360 degrees around the pipe at each marker location. The semi-rigid marker should include the legend and a directional flow arrow. The marker shall be supplied as a pre-tensioned device and be equipped with a 1/2 inch strip of adhesive on the inside to further secure the marker in a permanent position on vertical locations.
 - 2. For pipes with an overall diameter greater than 6 inches, including insulation, provide a semi-rigid plastic strap-on pipe marker with a height no less than 3 times the letter height. The marker shall include a legend and a directional flow arrow. Markers to be installed indoors shall be supplied with no less than two nylon straps to secure the marker in place. Markers to be installed outdoors shall be supplied with stainless steel or aluminum strapping.

2.02 DIRECTIONAL ARROWS

- A. Flow Direction: Provide flow directional arrows either as part of pipe markers, banding tape or separately, attached to pipes.
 - 1. Conform to requirements for markers.
 - 2. Size to conform to ANSI A13.1 (1 inch wide minimum).

2.03 DETECTABLE UNDERGROUND WARNING TAPE

- A. Description: Polyethylene tape resistant to acids, alkalis and other destructive soil components with metallic core for detection and location of piping with metal detector. Tape shall be a minimum of 6 inches wide with a minimum thickness of 5 mils. Utilize manufacturer's standard legends to identify water lines, pipe lines, gas lines, fuel lines, steam lines and sewer lines. Provide a continuous printed message with bold black lettering similar to "Caution Buried Water Line Below". Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material. The tape color shall conform to the American Public Works Association Uniform Color Code.

2.04 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. Red: Fire protection valves or equipment.

2.05 PLASTIC EQUIPMENT MARKERS

- A. General: Provide laminated plastic equipment markers for all scheduled items of fire protection equipment installed indoors.
- B. Size: Size laminated plastic markers not less than one inch in height and three inches in length with engraved lettering white on black not less than 1/4 inch in height. For larger pieces of equipment, size markers 1-1/2 inch in height by 4-1/2 inches long, of 3/32 inch laminated plastic melamine with white on black lettering engraved not less than 1/16 inch deep and 1/2 inch high.
- C. Attachment: Attach nameplates with rivets, stainless steel screws or bolts. On equipment such as tanks and pumps which cannot be drilled or pierced, attach nameplates with brass chains and "S" hooks.
- D. For fire protection equipment installed above ceiling, provide 3/4 inch by 2-1/2 inches laminate tags attached with rivets to the ceiling grid below.

2.06 ALUMINUM EQUIPMENT MARKERS

- A. General: Provide engraved anodized aluminum equipment markers for all scheduled items of plumbing equipment installed outdoors.
- B. Size: Size engraved aluminum markers not less than 1 inch in height and 3 inches in length with engraved lettering white on black background not less than 5/8 inch in height. For larger pieces of equipment, size markers 3 inches in height by 6 inches long, with lettering not less than 1 inch in height.
- C. Attachment: Attach nameplates with rivets, stainless steel screws or bolts. On equipment

such as tanks and pumps which cannot be drilled or pierced, attach nameplates with stainless steel chains and "S" hooks.

2.07 VALVE TAGS

- A. Materials: Provide indoor valve tags of solid brass with stamped or engraved lettering or numbers. Provide outdoor valve tags of aluminum with stamped or engraved lettering or numbers.
 - 1. Fill lettering and numbers with black paint.
 - 2. Lettering shall be not less than 1/4 inch in height.
 - 3. Numbers shall be not less than 1/2 inch in height.
- B. Attachment: For valve tags in mechanical rooms, provide with brass jack chain and "S" hook attachment. For all other indoor valve tags, provide with brass beaded chain attachment. For all outdoor valve tags, provide with stainless steel jack chain and "S" hook attachment.

2.08 ENGRAVED PLASTIC LAMINATE SIGNS

- A. General: Where indicated in other sections of the specifications, provide engraved instruction signs, warning signs, operational instructions or other signs designated.
- B. Emergency Operating Signs: For emergency operating instructions, provide engraved, laminate, melamine plastic, white on red, not less than 1/8 inch thick.
 - 1. Provide concise written instructions on the emergency operation of the device.
 - 2. Letters shall be not less than 5/16 inch in height, engraved 1/16 inch deep in block capital letters.
- C. Information and Warning Signs: Provide general information and warning signs of laminated, melamine plastic, not less than 1/8 inch thick, with white engraved lettering on black, with letters not less than 1/4 inch in height, block capitals.
- D. Attachment: Attach signs directly to the equipment with rivets, bolts or screws, if possible. Otherwise, attach signs with angle brackets, U-bolts, or metal plates held in place to piping with stainless steel draw-bands.
 - 1. Attachment with adhesives will not be permitted.
 - 2. Locate signs not less than 4 feet nor more than 6 feet above the operating floor, directly visible from an operating aisle.
 - 3. Locate signs to preclude damage during maintenance and repair or by operating traffic.

2.09 VALVE SCHEDULES AND FRAMES

- A. General: Provide valve schedules for all valves provided by Division 2.
- B. Schedules: Provide typed or machine printed schedules, one item per line, double spaced.

1. Printing shall be black on 8-1/2-inch by 11-inch white paper. Paper shall be waterproof or laminated after printing.
2. For each valve, list the valve number, location, size and use or operating function.
3. Support schedules in full extruded aluminum frames with removable, non-yellowing, clear plastic faces.
4. Screw or bolt schedules to equipment room walls where directed.
5. Coordinate valve numbers with valve tags so that no two valves or scheduled devices have the same number.

PART 3 EXECUTION

3.01 GENERAL

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Install identifying devices after completion of coverings and painting.
- C. Install labels with sufficient adhesive for permanent adhesion. For unfinished canvas covering, apply paint primer before applying labels.

3.02 CONCEALED VALVES AND EQUIPMENT

- A. Equipment Above Ceilings: Provide valve tagging and identification to equipment located above ceilings, such as valves and other items before the ceilings are installed.
- B. Finished Surfaces: Where identification is to be provided on surfaces which require insulation, painting and finishing, install identification after covering and painting is complete.
- C. Provide ceiling tacks to locate valves or equipment above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- D. Provide plastic nameplates adhered to the ceiling grid to locate valves, equipment, or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Label with tag of equipment.

3.03 PIPING SYSTEM IDENTIFICATION

- A. Install pipe markers on all piping systems and include arrows to show the normal direction of flow. Where flow can be in both directions, arrows in both directions shall be displayed.
- B. Identify piping exposed to view and concealed by accessible ceilings, including hard ceilings provided with access panels. Identify piping outdoors, in crawlspaces, on roof, above grade and within parking structures. Only piping located within walls or inaccessible areas need not be identified.
- C. Locate pipe markers as follows:

1. Every 15 feet on straight runs.
 2. At each valve and control device.
 3. At each branch or take-off. Provide flow arrows on the branch pipe as well as on the main on both sides of the branch.
 4. At any change in piping direction.
 5. Above and below every floor or roof penetration.
 6. On either side of every wall or partition. Ensure there is a minimum of one marker per pipe in every room.
 7. On either side of large obstructions, ductwork or equipment that piping passes above.
 8. At 5-foot intervals where piping is obscured by close proximity to walls or other pipes.
 9. Provide only one label per unit drain connection for condensate drain piping on roof.
- D. Install pipe markers so they are visible and legible from a normal standing position.
- E. Secure each end of self-adhesive pipe markers with a full wrap of banding tape of the same background color. Banding tape shall overlap itself a minimum of 3 inches.
- F. Provide mechanically applied pipe markers for all piping in mechanical rooms and outdoors.
- G. Install detectable underground warning tape 12 inches below finished grade, directly above buried pipe. If piping is buried more than 36 inches below finished grade, then provide an additional continuous length of tape buried 12 inches above the piping.

3.04 VALVE IDENTIFICATION

- A. General: Provide a valve tag on every valve, cock and control device in each piping system. Exclude check valves and valves within factory-fabricated equipment units. List each tagged valve in valve schedule for each piping system. In existing buildings, coordinate valve tags and schedules such that no valve numbers are duplicated.
1. Tagging Schedule: Comply with requirements of "Valve Tags" and "Valve Schedules and Frames" paragraph.
- B. Install valve schedule frames and schedules in machine rooms where indicated or where directed.
- C. Mark all sprinkler system valves in accordance with NFPA 13, and Division 21 Section "Wet Pipe Sprinkler Systems," "Dry Pipe Sprinkler Systems," or "Pre-Action Sprinkler Systems" or other as appropriate

- D. Identify Sprinkler Riser trim in accordance with NFPA 13, and Division 21 Section "Wet Pipe Sprinkler Systems," "Dry Pipe Sprinkler Systems," or "Pre-Action Sprinkler Systems" or other as appropriate.
- E. Fire Protection Valve and Trim Signage: Equipment identification signs used for indoor equipment shall be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gauge steel or 0.020 inch aluminum with red letters on a white background or white letters on red background. All text shall be a minimum 1" lettering.
- F. Fire Alarm System and Device Components: Identify fire alarm equipment devices by means of 3/32 inch (3 mm) thick red laminated phenolic nameplate with white core. Engrave fire alarm panel identification using a minimum size of 1 inch (25 mm) character height, Helvetica style font. Fire Alarm device numbers shall be a minimum of 3/16 inch (5 mm) size and fire alarm zone numbers shall be 1/4 inch (7 mm) size. Attach nameplates with No. 4-36 RH nickel plated brass machine screws. Device numbers may be adhered with glue or equivalent.

3.05 FIRE PROTECTION EQUIPMENT IDENTIFICATION

- A. General: Install equipment markers and identification on or near each major item of fire protection equipment. Provide signs for the following general categories of equipment and operational devices:
 - 1. Main alarm and operating valves.
 - 2. Meters and gauges.
 - 3. Pumps, air compressors and motor-driven units.
 - 4. Tanks and pressure vessels.
 - 5. Fire Department Connections
 - 6. Standpipe valves and cabinets
- B. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

3.06 COLOR AND IDENTIFICATION SCHEDULE

A. Provide all pipe labels and lettering of colors listed below:

<u>FLUID SERVICE TYPE</u>	<u>PIPE MARKER LEGEND</u>	<u>PIPE MARKER BACKGROUND / LETTERING COLOR</u>	<u>VALVE TAG LETTERING</u>
Fire Protection	FIRE PROTECTION WATER	Red/White	FP

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- A. See Specification 01 9113 General Commissioning Requirements.

END OF SECTION

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SECTION 21 13 13 – WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wet-pipe sprinkler system.
- B. System design, installation, and certification.
- C. Sprinkler heads.
- D. Piping Specialties.
- E. Fire department connections.

1.02 RELATED SECTIONS

- A. Section 21 00 01 – Basic Fire Protection Requirements
- B. Section 21 05 00 – Common Work Results for Fire Suppression.
- C. Section 21 05 53 – Identification for Fire Protection Piping.
- D. Section 21 12 00 - Fire Suppression Standpipes.
- E. Section 26 05 03 – Equipment Wiring Systems
- F. Section 28 31 00 – Fire Detection and Alarm.

1.03 REFERENCES

- A. FM Global:
 - 1. FM – Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
 - 2. FM Global Property Loss Prevention Data Sheets 2-0 – Installation Guidelines for Automatic Sprinklers.
 - 3. FM Global Property Loss Prevention Data Sheets 3-26 – Fire Protection Water Demand for Nonstorage Sprinklered Properties
- B. National Fire Protection Association:
 - 1. NFPA 13 – Standard for the Installation of Sprinkler Systems.
 - 2. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
 - 3. NFPA 25 – Standard for the Inspection, Testing and Maintenance of Water-

Based Fire Protection Systems.

4. NFPA 70 – National Electrical Code.
 5. NFPA 72 - National Fire Alarm and Signaling Code
- C. Underwriter’s Laboratories (UL):
1. UL – Fire Equipment Directory.
 2. UL 199 – Automatic Sprinklers.

1.04 SYSTEM DESCRIPTION

- A. The Sprinkler system shall provide coverage for building areas noted on Drawings. If the building is more than 52,000 square feet on any single floor, the system shall be divided into separate systems with multiple risers and alarm valves and shall be laid out accordingly.
- B. Provide hydraulically designed system(s) to meet NFPA 13 requirements for each occupancy classification, as indicated on Drawings.
- C. Determine volume and pressure of incoming water supply from water flow test data. Revise design when test data available prior to submittals.
- D. Interface system with building fire and smoke alarm system.
- E. Provide fire department connections as indicated on Drawings.

1.05 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Section 01 33 00 and Section 21 00 01.
- B. Submittals shall include all items listed in Section 21 05 00, including but not limited to: fire flow test data, product data, coordination drawings, shop drawings and local Fire Department approval.

1.06 SUBMITTALS AT PROJECT CLOSEOUT

- A. Submit under provisions of Section 01 70 00 – Execution and Closeout Requirements.
- B. Submittals shall include all items listed in Section 21 05 00, including but not limited to Project Record Documents, System Certification forms, Operation and Maintenance data and warranty forms.

1.07 QUALITY ASSURANCE

- A. Perform work to the local adopted building and fire codes (as listed on sheet FP1.1), NFPA 13, 24 and 25 as modified herein, the local authority having jurisdiction, FM Global standards (where applicable) and the Architect/Engineer. The greater quality and/or value specified herein for the system(s) and various components and installation procedures shall take precedence over the minimum requirements of NFPA, in all instances.
- B. All work shall be supervised by a minimum NICET II certified individual or higher as may

be required by the local AHJ. Certification shall be for above grade fire suppression installation.

- C. Sprinkler Shop Drawings and hydraulic calculations are to be sealed by a Professional Engineer, knowledgeable in fire protection engineering or a Responsible Managing Employee (RME) licensed by the State of Texas Fire Marshal Office, before submitting for review.
- D. Welding Materials and Procedures: Perform to ASME Code.
- E. Valves: Bear UL/FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- F. Piping: All piping installed on this project shall bear the complete ASTM and manufacturer marking, labeling and identification requirements as required by ASTM. All installed piping 3'-0" or greater in length shall be readily identifiable per ASTM labeling criteria. Piping not bearing this identification upon installation shall be removed and replaced by the correctly labeled piping. Piping shall not be re-stenciled after it is installed to meet these criteria.
- G. The system shall also conform to applicable requirements of the Texas Administrative Code Title 28, Chapter 34.

1.08 QUALIFICATIONS

- A. The work shall be performed by a person or organization with a current certificate of registration from the State Fire Marshal as an independent fire protection sprinkler contractor (Registered Firm). This contractor shall be fully responsible for all design to meet project requirements, including items exceeding those specifically illustrated or mentioned in the contract documents.
- B. The work shall be performed under the supervision of a licensed Responsible Managing Employee (RME) as defined by Texas Insurance Code (TIC), Chapter, Fire Protection Sprinkler System Service and Installation and the Texas Administrative Code Title 28, Chapter 34, Subchapter G – Fire Sprinkler Rules.
- C. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing Work specified in this section with minimum three years of documented experience.
- E. Although Contractor is responsible for design of system; sizes, routing and equipment shown on drawings and specifications shall be considered as minimum requirements, even if they exceed NFPA, FM and AHJ requirements. Contractor is reminded that other sections of specifications also apply to this work (i.e., refer to "Related Sections" above) and contractor shall comply with these sections even if they exceed NFPA, FM, and AHJ requirements.
- F. The system design and installation shall in all respects conform to the latest adopted editions of applicable NFPA, Building Code and Fire Code requirements, and any local modifications and/or amendments thereto. Where latest adopted editions vary between code authorities having jurisdiction (AHJ's) over this project, system shall meet the most stringent requirements. These requirements include, but not necessarily be limited to:
 - 1. NFPA 13 - Standard for the Installation of Sprinkler Systems.

2. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
3. NFPA 72 – National Fire Alarm and Signaling Code

1.09 DELIVERY, STORAGE AND PROTECTION

- A. Section 01 60 00 – Product Requirements: Transport, handle, store and protect products.
- B. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation.
- C. Utilize manufacturer supplied sprinkler caps, covers and bulb protectors. Remove all caps prior to placing system(s) in service.

1.10 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one-year manufacturer warranty for system components.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 – Execution and Closeout Requirements.
- B. Furnish, equip and install spare sprinkler cabinet(s) in accordance with provisions of NFPA 13. Locate near main system riser assembly or as indicated on Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 1. Grinnell
 2. Reliable Automatic Sprinkler Co.
 3. Tyco Fire Products
 4. Viking
- B. Section 01 60 00 – Product Requirements: Product options and substitutions. Substitutions.

2.02 SPRINKLER HEADS

- A. Unless otherwise specified or indicated on the drawings, sprinkler heads shall be regular automatic closed type spray heads with temperature ratings as required by National Fire Protection Association Standard No. 13.
 1. Where feasible, all sprinkler heads shall be quick-response type.

2. Finished Ceilings: Provide concealed ceiling sprinklers with factory finished (no field painting) cover plate, color to match ceiling finish. (Exception: Provide chrome plated or alternate color cover plates where directed by Architect).
 3. Unfinished Areas without Ceilings: Provide bronze upright. Protect sprinkler heads against mechanical injury with standard guards where required.
 4. Sidewall heads: Recessed horizontal sidewall type heads with white enamel finish and matching push on escutcheon plate may be utilized, where indicated on drawings.
- B. An approved protective guard in accordance with NFPA 13 Section 6.2.8 shall be installed on each sprinkler head located in rooms/areas where there is a potential to receive damage or where the head is less than 7 feet above the floor level. Sprinkler heads guards shall be listed for use with the sprinklers on which they are installed.
- C. The use of UL listed and FM approved flexible type head assemblies is permitted. Flex type head assembly shall consist of 304 stainless steel braided hose with zinc plated steel 1" NPT male threaded nipple, factory tested at 400 psi, complete with one piece head securing bracket assembly, tamper resistant screws. The drop shall include a UL approved braided hose with a bend radius to 2" to allow for proper installation in confined spaces.

2.03 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber-faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.
- B. Riser Manifold Assembly: Factory assembled unit of painted ductile iron body with brass and galvanized trim, containing a dedicated water flow detector switch with two sets of electrical contacts; a pressure gauge with three-way isolation valve; a built-in drain port with a test and drain valve assembly; and a pressure relief kit. Entire assembly shall be UL Listed and FM approved as a unit for installation in either horizontal or vertical position and shall have cast on lettering to identify manifold pipe size, flow direction, and gauge and drain outlets.
- C. Floor Control Assembly: Factory assembled unit of stainless steel or painted ductile iron body with brass and galvanized trim, containing a dedicated water flow detector switch with two sets of electrical contacts; a pressure gauge with three-way isolation valve; and a built-in drain port with a test and drain valve assembly. Entire assembly shall be UL Listed and FM approved as a unit for installation in either horizontal or vertical position and shall have cast on lettering to identify manifold pipe size, flow direction, and gauge and drain outlets.
- D. Fire Department Connections: Refer to Section 21 05 00.
- E. Backflow Preventer Assembly: Refer to Section 21 05 00.
- F. Electric Alarm and Water Motor Alarm: Refer to Section 21 05 00.
- G. Water Flow Switches and Supervisory (Tamper) Switches: Refer to Section 21 05 00.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with NFPA 13, and in accordance with local Fire Department requirements.
- B. Install equipment in accordance with manufacturer's instructions.
- C. Locate outside alarm gong on building wall as indicated.
- D. Place pipe runs to minimize obstruction to other work.
- E. Center sprinklers in ceiling tile in one direction and provide piping offsets as required with location in other direction variable, dependent upon spacing and coordination with ceiling elements.
- F. Apply cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.
- G. Install guards on sprinklers where indicated.
- H. Locate drains and inspectors test as indicated on drawings or in a location approved by the Architect/Engineer.
- I. Flush entire piping system of foreign matter.
- J. Hydrostatically test entire new piping system per NFPA 13, as noted below.
- K. Provide both a Hydraulic Design Information Sign and a General Information Sign near each systems control riser. Signs shall be of permanently marked weatherproof material and shall include all information outlined in NFPA 13.
- L. Paint all exposed sprinkler piping as specified in Section 21 05 00.
- M. Under no conditions shall paint be applied to sprinkler heads, escutcheons, or covers. If paint is so applied, replacement of the affected parts shall be required.

3.02 INTERFACE WITH OTHER PRODUCTS

- A. Ensure required devices are installed and connected as required to fire alarm system.

3.03 CLEANING

- A. Section 01 70 00 – Execution and Closeout Requirements: Final cleaning.
- B. Flush entire system of foreign matter.

3.04 TESTING

- A. The installing contractor shall do the following:
 - 1. Notify the Fire Marshal, any other authority having jurisdiction and the Owner's authorized representative of the time and date testing will be performed.

2. Perform all acceptance tests required by Chapter 25 of NFPA 13; including hydrostatic tests, main drain test, system operational tests, backflow prevention assembly test and pressure reducing valve tests.
3. Complete and sign the appropriate Contractor's Material and Test Certificate, and forward Certificate(s) to the authority having jurisdiction.
4. The contractor shall coordinate with the Owner's insurance provider for a system inspection and approval and for the completion of the Contractor's Material Test Certificate (CMTC).

3.05 OCCUPANCY CLASSIFICATIONS

<u>Location</u>	<u>Occupancy Classification</u>
Institutional	Light Hazard
Educational	Light Hazard
Offices	Light Hazard
Janitor Closets	Ordinary Hazard, Group 1
Mechanical Rooms	Ordinary Hazard, Group 1
Electrical Rooms, with Dry Type Transformers	Ordinary Hazard, Group 1
Electrical Rooms, with Liquid-Filled Transformers	Ordinary Hazard, Group 2
Miscellaneous Storage Rooms (with storage height up to 12')	Utilize the design criteria and appropriate protection criteria and density curves of NFPA 13, Chapter 13.

END OF SECTION

SECTION 22 00 01 – BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic Plumbing Requirements specifically applicable to each Division 22 Section, in addition to Division 1 - General Requirements.

1.02 REFERENCES

- A. All references in Division 22 to codes, standards or other publications shall be the latest edition/version, unless noted otherwise.

1.03 PLANS

- A. These specifications are accompanied by plans indicating typical layouts, pipe and equipment location, etc. The plans and these specifications are complimentary each to the other and what is called for by one shall be as binding as if called for by both. Should there be a conflict between drawings and specifications regarding a material shown of work described or detailed then the material of work having the greater value shall be provided.
- B. The plans as prepared are in general diagrammatic. The contractor shall carefully lay out his work at the site to conform to the architectural, mechanical, electrical and structural conditions to provide grading of piping, to avoid all obstructions and to conform to details of installation as shown on the plans and supplied by the manufacturers of the equipment to be installed, and thereby to provide an integrated satisfactorily operating installation. **The General Contractor must coordinate the work of all trades.** All necessary offsets in piping, fittings, ductwork, etc. required to avoid interferences between piping, equipment, structural and architectural work are not shown but shall be furnished and installed by the contractor without additional expense to the Owner.
- C. These specifications and plans accompanying same are intended to cover systems which will not interfere with the design of the building, which will fit into the available spaces, and which will insure complete and satisfactory systems. Each contractor shall, therefore, carefully examine the plans and the building and shall be responsible for the proper fitting of his material and apparatus into the building.
- D. The size of plumbing equipment indicated on the plans is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space with the manufacturer's recommended clearances allocated for same on the plans. It shall be the Contractor's responsibility to furnish data to evidence that sufficient space can be provided for the installation of proposed equipment and that adequate access will exist for servicing and maintenance of equipment. Should changes become necessary during construction, the contractor shall make such necessary changes at his (the Contractor's) own expense.
- E. Exceptions and inconsistencies in plans and specifications shall be brought to the Architect's attention no later than ten (10) days prior to the bid date, unless specified otherwise in Division 1. Otherwise, the Contractor shall be responsible for any and all changes and additions that may be necessary to accommodate his particular apparatus

or equipment.

1.04 CHANGES

- A. Any changes from the plans necessary to make this work conform to the building as it is constructed, to make this work fit the work of other trades or to make this work conform to the rules of city and municipal bodies having jurisdiction shall be made by this contractor at no additional cost to the Owner. However, no changes shall be made from the work described on the plans and these specifications except on written order from the Architect.
- B. If any changes are required other than those mentioned above and the changes involve extra work on the part of the contractor, no charges for this extra work shall be allowed unless authorized in advance of the work by a written order from the Owner and/or Architect stating the charges to be made for the work.
- C. Proposed use of item or equipment other than that specified or indicated may require redesign of structure, partitions, foundations, piping, wiring, or other parts of mechanical, electrical, or architectural layout. Redesign, new drawings, and detailing required shall be prepared and submitted to Architect/Engineer for approval.
- D. Where approved deviation requires different quantity, size and arrangement of wiring, conduit, equipment, etc. from that specified or indicated; provide such items and all other additional equipment required by system at no additional cost to the Owner.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Protection:
 - 1. All work, equipment and materials shall be protected at all times to prevent damage or breakage either in transit, storage, installation or testing. All openings shall be closed with caps or plugs during installation.
 - 2. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
 - 3. Damaged equipment or material shall be replaced with new as determined and directed by the Architect or Engineer. In particular, piping insulation which becomes saturated will be rejected and must be removed from the job site. Such repair or replacement shall be at no additional cost to the Owner.
 - 4. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
 - 5. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Owner.
4. Boilers shall be left clean following final internal inspection by the inspector.
5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.06 SUBSTITUTIONS

- A. The materials, products and equipment described and specified establish a standard of quality, function, dimension and appearance to be met by any proposed substitutions.
- B. Reference Section 01 60 00 – Product Requirements.
- C. Substitution requests are only required where specific manufacturers are listed or scheduled.

1.07 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. The Contractor shall furnish copies of the manufacturer's literature and drawings describing all proposed equipment and materials indicated in the specifications. The proposed use of the exact equipment and materials specified shall not change this requirement of including literature describing the proposed equipment. Manufactured items proposed for use, whether specified or proposed for substitution, shall be the current, catalogued product of the manufacturer, and replacement parts shall be available.
- C. Manufacturer's regular catalog sheets will not be acceptable under this requirement unless they indicate completely all of the specification requirements. Where drawings cover several sizes or types of construction they shall clearly indicate the size or type of construction to be used on the project. In cases where several sizes of the same type of equipment are required to be furnished, the submittal shall include a schedule identifying each piece of equipment, complete with all capacity information needed to compare every submitted item with its respective specified item. **Annotate all submittal data to indicate exact model, size, and type submitted.**
- D. Brochures shall contain a certification that the equipment or materials are suitable for conditions shown and specified; that the equipment or materials are believed to be in conformity with the plans and specifications, except as may be specifically described and that approval is recommended. The certification shall be signed by the Contractor. Brochures received not in conformity with these requirements will be returned for required actions. Any deviation from the requirements of the specifications shall be clearly noted and marked for the Engineer's consideration.
- E. Approval of the brochures, or any part of the contents therein, shall not eliminate

responsibility for compliance with the plans and specifications, unless specific attention has been called in writing to proposed deviations at the time of transmittal of the brochures and such deviations have been approved, nor shall it eliminate the requirements or the responsibilities, if there are errors of any sort in the data submitted.

1.08 INTERFERENCES AND COOPERATION

- A. The plans are generally diagrammatic and the Contractor shall coordinate the work of the different trades so that interferences between piping, equipment, structural and architectural work will be avoided. Not all offsets in piping, ductwork, etc., are shown. The Contractor shall cooperate with the General Contractor and all other contractors to coordinate their work to avoid interferences and delays and arrange all parts of the work to harmonize in service and appearance with all other parts.
- B. The General Contractor shall coordinate the work of all trades. The various systems to be installed shall follow the normal, common sense priority of systems installation with the highest system to lowest system installation as follows:
1. HVAC ductwork shall be installed up and against building (floor/roof) structural members.
 2. Sanitary waste and storm drainage piping system shall begin horizontal routing as high as possible between structural members, offsetting vertically only to avoid conflict with structure or to drop below HVAC ductwork where offset is unavoidable.
 3. Electrical conduit shall be installed up, and against building structure, running parallel with HVAC ductwork and offsetting up into structural bay (void) or below HVAC ductwork to obtain a change in direction or branch take-off. Electrical conduit installation shall not control or dictate the routing or installation of the HVAC ductwork storm drain piping or sanitary waste and vent piping.
 4. Domestic water piping (hot water, cold water and hot water return), medical gas piping and HVAC piping shall be installed beside and below the HVAC ductwork and electrical conduit. Preferred installation shall be on trapeze, wall brackets, or racked on vertical channel on the wall above the ceiling line. The completed installation shall not conflict with the installation or removal of ceiling system components or tile. All main and branch take-off isolation valves, strainers, sensors and other plumbing equipment shall be readily identifiable and accessible from a standing position on a step ladder, no more than 18 inches above ceilings.
 5. Fire sprinkler piping system shall be installed below all other systems and components, unless noted otherwise or as coordinated with all other trades. The fire sprinkler piping shall not conflict with the installation or removal of ceiling system components or tile. The fire sprinkler system piping layout and installation shall be coordinated by the fire sprinkler contractor and the General Contractor with all other trades performing work in the affected area, to avoid conflict with the installation or removal of any other systems components, or to prevent ready access to valves, equipment of the other trades. Do not install sprinkler piping until ductwork mains are in place.
- C. Provide an overhead coordination submittal per Section 01 30 00. The submittal shall include all structural, plumbing, mechanical, electrical, and fire protection components.

1.09 MATERIALS AND WORKMANSHIP

- A. All materials shall be new, of the quality specified and free of any defects. Manufacturer's names are listed to establish a standard of quality and construction.
- B. The Contractor will be responsible for transportation of his materials to the job and for their storage and protection until the final acceptance of the job.
- C. Contractor shall furnish all necessary scaffolding, tackle, tools and appurtenances of all kinds and all labor required for the safe and expeditious execution of his contract.

1.10 PERMITS AND INSPECTIONS

- A. The Contractor will be responsible for all permits and inspections required by law for the completion of his work. Cost of all permits and inspections shall be paid for by the Contractor. The Contractor shall obtain and pay for all certificates of approval which must be delivered to the Architect before final acceptance of the job. All materials and labor furnished by the Contractor shall be in strict accordance with the rules and requirements of the National Board of Fire Underwriters, state and municipal regulations and other authorities who may have lawful jurisdiction over the work being done.
- B. Each contractor shall be responsible for coordinating their work with the General Contractor and scheduling AHJ required inspections through the General Contractor to allow inspections to be performed without impeding the progress of construction. Generally, the Contractor shall plan for inspections to occur two (2) weeks prior to the scheduled concealment of work in the area of inspection.

1.11 ENGINEERING DESIGN TEAM OBSERVATIONS

- A. Each contractor shall be responsible for coordinating their work with the General Contractor and scheduling progress observations through the General Contractor to allow for the following observations to be performed without impeding the progress of construction. Generally the Contractor shall plan for observations to occur two (2) weeks prior to the scheduled concealment of work in the area of observation.
- B. In general, observations for this project shall include but not be limited to:
 - 1. Exterior Below Grade: Site utilities and services.
 - 2. Interior Below Grade: Utilities, services and systems.
 - 3. Rough Wall: All utilities, services and systems in-place including wall studs, cross bracing, supports, etc. (No sheetrock or insulation).
 - 4. Corrected Rough Wall: (Before Sheetrock).
 - 5. Above Ceiling: All utilities, services and systems in place, labeling on exposed piping (No insulation on piping systems. Ceiling grid/channels may be installed but no sheetrock or ceiling tile).
 - 6. Above Ceiling Final: All utilities, services and systems complete including hangers, insulation, and labeling (ceiling grid and/or channel may be in place but no sheetrock or ceiling tile shall be installed).

7. Substantial Completion: All surfaces complete, fixtures installed and trim-out complete.
8. Final: Cleaned and ready for occupancy.

1.12 EXAMINATION OF SITE

- A. All Contractors submitting proposals for this work shall first examine the site and all conditions thereon and therein. All proposals shall take into consideration conditions as may affect the work under this contract. They shall satisfy themselves as to existing grades and the actual formation, and soil conditions.
- B. Contractors shall verify all service locations, depths, sizes, etc. No information given on the plans shall relieve the Contractor of this responsibility.
- C. Before starting work, the Contractor shall verify all associated existing systems, pipe sizes, locations, and dimensions so that the new systems can be properly connected as indicated on the documents.

1.13 QUALITY ASSURANCE

- A. Perform Work in accordance with all codes listed on the drawing sheets, the local authority having jurisdiction (AHJ), and the Architect/Engineer. As the minimum standard for the level of quality, in all cases the greater quantity or better quality shall be the first consideration for the basis of an acceptable product or process. The local authority having jurisdiction, the Architect and the Engineer shall have the final authority on the approval and/or use of any product or process specified or submitted for substitution. The greater quality and/or value specified herein for the system(s) and various components and installation procedures shall take precedence over the minimum requirements of the herein before mentioned codes.
- B. Equipment and Components: Bear UL, ASME, ANSI and/or NSF label or marking, as specified in appropriate Section.
- C. Valves: Provide manufacturer's name and pressure rating marked on valve body.
- D. Piping: All piping installed on this project shall bear the complete ASTM and Manufacturer's marking. Labeling and identification requirements as required by ASTM. All installed piping 5'-0" or greater in length shall be readily identifiable per ASTM labeling criteria. Piping not bearing this identification upon installation shall be removed and replaced by the correctly labeled piping. Piping shall not be re-stenciled after it is installed, to meet this requirement.
- E. Lead free components: All wetted surfaces of piping, fittings, valves and other products in contact with the potable water system shall be certified as lead free, as per current requirements of NSF/ANSI 61 and/or NSF/ANSI 372.
- F. Welding Materials and Procedures: Perform to ASME Code.

1.14 CONTROLS

- A. Where “automatic controls” are called for in the plans and specifications, all the control instruments, such as motorized valves, etc., shall be provided by the Contractor. The Drawings may show some power connections to controls equipment; however, if more power is required, then the Contractor shall provide this power.

1.15 UNIONS

- A. No unions are to be placed in any pipe in a location which will be concealed or inaccessible after completion of the building unless furnished with an access panel either as shown on the drawings or as specified herein. Unions must be installed on each side of all pieces of equipment such as water heaters, water softeners, thermostatic mixing valves, flow regulators, pumps, etc., so that such equipment may be readily disconnected in location that equipment can be disconnected and removed.

1.16 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- F. Electrical and Pneumatic Interconnection of Controls and Instruments: This is generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- G. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- H. Work in Existing Building: Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills, will be permitted only with approval of the Owner. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to Cutting and Patching article in Part 3 of this section.

1.17 TEMPORARY PIPING AND EQUIPMENT

- A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities, when required by the phasing or called for specifically on the plans.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities.
- C. When construction is complete, temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs in potable water systems will not be allowed. Provide necessary blind flanges and caps to seal open piping remaining in service.

1.18 UTILITIES

- A. The Contractor shall coordinate work and arrange and pay for any necessary revisions to existing utility services, including meter deposits and connection fees to all serving utility companies and shall install utilities, where applicable.
- B. The Contractor shall be responsible for all costs associated with the extension of utilities to the Building, including but not limited to natural gas, domestic water, sanitary sewage and storm drain piping.
- C. The Contractor shall be responsible for gathering all information required by the connecting utility service provider (i.e. drawings, load information, completing and submitting required forms, etc.) The contractor may utilize the design team to obtain information, however, the contractor is responsible for submitting all required documentation to the utility provider. This includes, but is not limited to, new gas service, medium pressure gas request forms, water meter sizing forms, etc.).
- D. The Contractor shall provide the utility service provider a date that the utility connection is needed. This date shall be coordinated with the utility service provider to take into consideration the design time and mobilization.

1.21 INDOOR AIR QUALITY CONTROL:

- A. All Adhesives, sealants, paints, coatings applied within the weatherproofed interior of the building shall comply with applicable VOC thresholds of SCAQMD 1113 and 1168.

PART 2 PRODUCTS

2.01 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 - 1. All components of an assembled unit need not be products of same

manufacturer.

2. Constituent parts that are alike shall be products of a single manufacturer.
 3. Components shall be compatible with each other and with the total assembly for intended service.
 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.02 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.03 ESCUTCHEONS AND PLATES

- A. Where pipes pass through ceilings (any type: i.e. lay-in, gypsum, etc.) or walls in finished spaces, install sectional plates or escutcheons to cover the annular opening between pipe and sleeve. Solid plates with set screws shall be used where the sectional plates will not stay in place or are not available in the required size, or where other individual specification section(s) require one piece or greater quality escutcheons or plates.
- B. Inside diameter of escutcheons shall fit around insulation and around pipe when not insulated; outside diameter shall cover sleeve. Secure escutcheons or plates to pipe or sleeve but not to insulation. All escutcheons shall be triple nickel-chromium plated brass, or type 316L stainless steel.

2.04 INSULATION

- A. All insulation materials used inside the building on this project, including finishes and adhesives on the exterior surfaces of ducts, pipes and equipment shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255 as required by NFPA 90A, unless noted otherwise acceptable.

2.05 SOLENOID VALVES

- A. All solenoid valves used in piping systems shall be the slow acting type.

2.06 ASBESTOS

- A. Materials containing asbestos are not permitted.

- B. If any asbestos-containing material is discovered or suspected, the contractor shall immediately cease any and all work in that area. Cover the exposed material in plastic containment without disturbing the exposed material and notify the Architect and the Owner's representative.
- C. Certify in writing that neither the Contractor nor any of Contractor's subcontractors or suppliers will supply any materials that contain any asbestos in any form for this Project.

PART 3 EXECUTION

3.01 ACCESS PANELS

- A. All valves, traps, drains, cleanouts, equipment, etc., must be accessible. The Contractor shall, wherever required to service his installation, coordinate size and location of access panels with General Contractor. Refer to Section 08 31 13 – Access Doors and Frames.

3.02 FIRESTOPPING

- A. Firestopping: Unused slots, sleeves and other penetrations in floors, walls or other general construction shall be closed and sealed with an approved firestopping material.
 - 1. Reference Section 07 84 00 – Firestopping for appropriate firestopping material and method of installation required for each wall rating and penetration size and type to comply with the appropriate UL listing.
 - 2. Floor slots and openings shall be closed with 16 gauge galvanized steel sheet supported on 1-inch by 1-inch by 1/8-inch structural angle drilled or supported with powder-driven studs into the building structure. Firestop with a layer of silicone elastomer not less than 1-inch thick which completely fills the opening. The top surface of the silicone elastomer shall be approximately 1-inch below the finished floor slab.
 - 3. Openings in walls shall be closed with 16 gauge galvanized steel sheet securely attached at the midpoint of the wall thickness and firestopped on both sides of the steel sheet with not less than 1/8-inch thick layer of non-sagging silicone elastomer to fully cover the opening.
 - 4. Single or multiple pipes passing through walls and floors shall have the annular space between pipes or between pipes and structure filled with silicone elastomer to provide a rated firestop (rated to match the assembly) for floors and walls.
- B. The annulus between exposed pipe and walls or floors in finished spaces shall be refilled, sealed and painted to match adjacent surfaces.
- C. Future Slots: Cap ends of sleeve and mark as future.

3.03 PAINTING

- A. Types of paint shall be as specified in the Architectural specifications. Surfaces to be painted are identified in Section 09 90 00 and on the drawings. All exposed gas piping shall be painted as noted in Section 22 11 23.
- B. All surfaces to be painted shall be thoroughly cleaned, all rust scraped off and all oil and

grease removed before any paint is applied.

- C. Finishing paint coats shall not be applied until all the work is completed. Cloths shall be spread where necessary to prevent drops of paint, oil, etc. from defacing walls, floors, etc., and the Contractor shall be held responsible for all damage by neglect of such precautions. The finished conditions of the painting shall be subject to the approval of the
- D. Architect, who may require retouching or repainting of surfaces not properly finished.

3.04 PRODUCTS NOT FURNISHED BUT INSTALLED UNDER DIVISION 22.

- A. Rough-in for and make final connection to Owner furnished fixtures and equipment requiring plumbing services.
- B. Rough-in for and make final connection to fixtures and equipment furnished under other divisions of these Contract Specifications requiring plumbing services.

3.05 EXCAVATING AND BACKFILLING

- A. The Contractor shall do all excavating and backfilling necessary for the installation of the work, including shoring, bailing and pumping to maintain his trenches and keep them in dry condition until the work in question has been tested and approved.
- B. Care shall be taken that piping is properly and uniformly graded and that trench beds are well rammed and that ground under pipelines is firm and secure before piping is laid. All trenches must be backfilled with clean sand, four inches under pipe, rammed down, soaked with water and made solid. All surplus material shall be removed and carted away.
- C. The Contractors will be responsible for resurfacing all areas after trenches have been backfilled.
- D. The Contractor is directed to comply with all OSHA Requirements and State Requirements regarding trench safety.
- E. Perform all work with the highest regard to safety and in accordance with U.S. 29 CFR 1926 "Safety and Health Regulations for Construction". Special attention shall be directed to Subpart P – Excavations. Refer also to 230010.1.12 – Safety.

1. Safety Precautions and Programs

- a. In excavations that are four (4) feet or more in depth, means of egress shall be provided by stairway, ladder, ramp or other safe means so as to require no more than twenty-five (25) feet of lateral travel for employees.
- b. In addition, on projects in which trench excavation will have a depth of five feet or more, the Contractor, and all of their subcontractors, shall comply with all requirements of 29 CFR 1926 Subpart P 652 "Safety and Health Regulations for Construction – Excavations" and all Appendices related thereto.
- c. Before commencing any trench excavation that will be five (5) feet deep or deeper, provide Owner, through A/E, with detailed plans and specifications regarding the safety systems to be utilized. Said plans and specifications shall include a certification from a registered professional engineer indicating full compliance with the 29 CFR 1926 Subpart P --

- Excavations.
- d. Contractor shall ascertain, prior to proposal, whether or not such conditions prevail and services are needed, and shall include cost of same in proposal.
- 2. All shoring and bracing shall be designed so that it is effective to the bottom of the excavation. Sheeting, sheet piling, bracing, shoring, trench boxes, and other methods of protection, including sloping, shall be based upon the condition and nature of the materials to be retained, and by loads (including surcharge) imparted to the sides of excavation by equipment and stored materials.
 - 3. Store excavated or other materials a minimum of two feet (2') from the edge of any excavation. Retain such materials to prevent their falling or sliding into the excavation, and to prevent excessive pressure on the sides of the excavation.
 - 4. Maintain sides and slopes of excavations in a safe condition by scaling, benching or barricading.
 - 5. Take other precautions via shoring and bracing to prevent slides or cave-ins. Take special precautions when trenches are located adjacent to backfilled excavations, or subjected to vibrations from railroads, highway traffic, operation of machines, etc.
- F. Verify locations of all existing utilities in the area prior to start of excavation (gas, electrical, water, sanitary, storm, telephone, cable TV, optical cable, etc.). Coordinate with utility companies as required.
- 1. Excavation within four feet (4') of existing utilities shall be done by hand digging only.
- G. Where conditions require concrete or other materials to be placed against undisturbed earth surfaces, any loosened or disturbed materials shall be removed from such surfaces.
- H. Trenching
- 1. Trenches shall be large enough to permit handling of pipe and accessories and making connections. For cast iron pipe installation, trench bottom width shall exceed bell or coupling diameters by at least twelve inches (12").
 - 2. Trenches in rock, soil containing rocks larger than two (2) inches in any dimension, and other non-uniform materials, shall be four (4) inches minimum and twelve inches (12") maximum below the bottom of the pipe to provide for a bedding course.
- I. Preparation of Trench Bottom
- 1. If the excavation is carried below the finished flow line grade of the pipe in order to remove unsuitable material or for any other reason, the trench shall be course bedded to within six inches (6") of the finished flow line grade of the pipe bottom with compacted load-bearing backfill. A bedding course as specified below shall then be placed over the load-bearing backfill.
 - 2. Trenches shall be dry when the trench bottom is prepared. A continuous trough

with compacted bedding course shall be prepared to receive the bottom quadrant of the pipe barrel. Remove loose or disturbed material and bring the trench bottom up to grade with bedding material as follows:

- a. For active soils where metallic piping is used, washed pea gravel with material no larger than 1/2 inch in largest dimension shall be utilized. Provide a Bentonite plug in the trench at the building perimeter where site drainage or other conditions could permit water intrusion into the trench under the building. Bentonite plug to extend 2 ft. on either side of the perimeter grade beam. (Sand bedding material may be substituted beyond ten (10) feet from building line only.)
 - b. NOTE: Confirm soil conditions prior to trenching. In general, soils with a plasticity index (PI) over 10 at depths to be encountered are considered active. Refer to Geotechnical Report included in project Specifications for PI value and additional information.
3. In addition, for bell joint pipe, excavation for the bell or coupling shall be so that the pipe will bear on the trench bottom along the entire length of the barrel.
 4. Prepare the trench bottom carefully so that when placed in its final position, the pipe will be true to line and grade and uniformly supported.

J. Laying Pipe

1. All pipe shall be clean at the time it is placed in the line. Open ends of pipe sections already in place shall be tightly plugged to prevent the entrance of trench water, mud, dirt, etc.
2. Keep trench bottom free of frost, frozen earth or standing water at the time of pipe laying and jointing.

K. Compaction

1. Where compaction is indicated by specifications, accomplish same with vibratory or rammer type compactor, minimum of two full width passes.
2. Compaction below slabs, roads, flatwork, or other construction elements shall be performed to the requirements of compaction for those elements. Coordinate with general construction trades and other Division's specifications.

L. Backfilling

1. Clean trenches and backfill material of any organic material, roots, trash, lumber, other debris and frozen material prior to backfilling. Backfill material shall contain no organic material, roots, trash, lumber, other debris or frozen material. Backfill material under slabs inside building shall match adjacent materials and be of density acceptable to the A/E.
2. Backfilling by means of sluicing or flooding with water is not permitted. Backfill shall not be placed on frozen ground.
3. Partially backfill immediately after the pipe is laid (unless other methods for anchoring pipe are provided). Leave joints exposed for hydrostatic testing. Water shall not be permitted to rise in unbackfilled trenches after pipe has been placed.

4. Whenever timber or other sheeting is driven to a depth below the elevation of the top of the pipe, that portion of the sheeting below a point four feet above the elevation of the top of the pipe shall not be disturbed or removed.
 5. Pipe layer backfill (bedding material under the bottom quadrant of the pipe, around sides, and up to a point one foot above the top of the pipe) shall be: sand or select material containing rocks no larger than 1/2 inch in greatest dimension (sand only shall be used with all plastic piping systems or plastic jacketed piping systems); except that pipe layer backfill below slabs in active soils shall be washed pea gravel of 1/2 inch minus dimensions. Backfill below slabs may utilize flowable fill.
 6. Backfill material shall be placed and compacted in six inch (6") layers. Backfill shall be brought up evenly on both sides of the pipe simultaneously to avoid damage or displacement from unbalanced loading.
 7. Joints shall not be covered with backfill until pressure and leak testing is completed.
 8. Backfill to grade (above pipe layer).
 - a. Active Soils: Where active soils are encountered backfill to grade within ten (10) feet of building line shall be uncompacted washed pea gravel to match the pipe layer backfill specified above.
- M. The Contractor shall also comply with requirements set forth in Division 31 Drawings and Specifications.

3.06 RIGGING

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Owner operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Restore building to original condition upon completion of rigging work.

3.07 CLOSE OUT DOCUMENTATION AND TESTING REPORTS

- A. Contractor shall provide Project Record Documents, Operation and Maintenance data

and all product warranty data as specified in Section 01 70 00.

- B. Contractor shall also provide copies of all plumbing system test and certification reports for inclusion in project close out documents. Reports shall include, but shall not be limited to, the following:
1. Piping system pressure test reports (per Sections 22 11 00, 22 11 23, 22 13 00 and 22 14 00),
 2. Domestic water disinfection tests (per Section 22 11 00),
 3. Backflow prevention assembly certifications (per Section 22 11 00),
 4. Domestic hot water systems tests (per Section 22 11 00),
 5. Medical Gas system verification tests (per Section 22 60 13).

END OF SECTION

SECTION 22 05 29 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Perform all Work required to provide and install supports, hangers, anchors, sleeves and bases for all plumbing piping, equipment, system components and accessories, indicated by the Contract Documents with all supplementary items necessary for complete, code compliant and approved installation.
- B. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Accessories.
 - 3. Flashing.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Formed steel channel.
 - 7. Equipment bases (housekeeping pads).
- C. Related Sections:
 - 1. Section 03 10 00 – Concrete Forming and Accessories: Execution requirements for placement of inserts and sleeves in concrete forms specified by this section.
 - 2. Section 03 30 00 – Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
 - 3. Section 07 84 00 – Firestopping: Product requirements for firestopping for placement by this section.
 - 4. Section 07 90 00 – Joint Protection: Product requirements for sealant materials for placement by this section.
 - 5. Section 22 00 01 – General Plumbing Requirements.
 - 6. Section 22 05 48 – Vibration Controls for Plumbing Piping and Equipment.
 - 7. Section 22 11 00 – Facility Water Distribution: Execution requirements for placement of hangers and supports specified by this section.
 - 8. Section 22 13 00 – Facility Sanitary Sewerage: Execution requirements for placement of hangers and supports specified by this section.
 - 9. Section 22 14 00 – Facility Storm Drainage: Execution requirements for placement of hangers and supports specified by this section.
 - 10. Section 22 17 00 – Facility Natural Gas Piping: Execution requirements for

placement of hangers and supports specified by this section

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.2 – Fuel Gas Piping.
 - 2. ASME B31.9 – Building Services Piping.
- B. ASTM International:
 - 1. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 – Method for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 – Test Method of Fire Tests of Through Penetration Firestops.
 - 4. ASTM F708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.
 - 5. ASTM E1966 – Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 – Structural Welding Code – Steel.
- D. FM Global:
 - 1. FM – Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 – Pipe Hangers and Supports – Materials, Design and Manufacturer.
 - 2. MSS SP 69 – Pipe Hangers and Supports – Selection and Application.
 - 3. MSS SP 89 – Pipe Hangers and Supports – Fabrication and Installation Practices.
 - 4. MSS SP 90 – Guidelines on Terminology for Pipe Hangers and Supports.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 – Fire Tests of Building Construction and Materials.
 - 2. UL 723 – Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 – Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 – Tests for Fire Resistance of Building Joint Systems.
 - 5. UL – Fire Resistance Directory.
- G. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH – Certification Listings.

1.03 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers catalog data including load capacity of hangers and supports.
- C. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- E. Manufacturer's Installation Instruction: Submit special procedures and assembly of hanger and support components.
- F. UL/FM assembly sheets or WH assembly sheets for fire rated penetrations.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three (3) years of documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum 3 years of documented experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements: Environmental conditions affecting products on site.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

- B. Contractor shall review all drawings, including structural drawings, for details regarding pipe supports, housekeeping pads, anchors, hangers, and guides.

1.09 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Refer to individual system and equipment Specification Sections for additional support requirements. Comply with MSS SP-69 for support selections and applications that are not addressed within these Specifications.
- C. Utilize hangers and supports to support systems under all conditions of operation, allowing free expansion and contraction, and to prevent excessive stresses from being introduced into the structure, piping or connected equipment.
- D. All pipe supports shall be of the type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
- E. Design hangers to impede disengagement by movement of supported pipe.
- F. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.
- G. Wire or perforated strap iron will not be acceptable as hanger material.
- H. Hanger rods shall be threaded on both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
- I. Fasteners requiring explosive powder (shooting) or pneumatic-driven actuation will not be acceptable under any circumstances.
- J. Nail drive anchors, plastic anchors or plastic expansion shields will not be permitted under any circumstances.
- K. Each hanger shall be properly sized to fit the supported pipe or fit the outside of the insulation on lines, hangers shall not penetrate insulation. Hangers shall bear on the outside of the insulation, which shall be protected by support shields as specified. For piping larger than 2", protect insulation from crushing by means of a section of rigid insulation to be installed at hanger points. Refer to Section 22 07 00.

- L. Hangers and clamps supporting and contacting individual non-insulated brass or copper lines shall be copper or copper plated. Support individual non-insulated brass or copper lines 4 inches and smaller with adjustable swivel ring hangers. Where non-insulated brass or copper lines are supported on trapeze hangers or channels, the pipes shall be isolated from these supports with approved flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp. Plastic tape is not acceptable.
- M. Hangers and clamps supporting and contacting plastic piping shall be in accordance with the piping manufacturer's published recommendations and shall be factory coated or padded to prevent damage to piping.
- N. Field fabricated supports shall be constructed from ASTM A36/A36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.
- O. Provide adjustable spring type hangers/isolators on all pipe hangers on the first 15 feet of pipe entering the building and where piping offsets vertically from one floor level to another.
- P. Provide adjustable spring type vibration isolation hangers for piping connected to isolated equipment (i.e. pumps, etc.). Refer to Section 22 05 48.
- Q. Finishes:
 - 1. All ferrous hangers, rods, inserts, clamps, stanchions, and brackets on piping within interior non-corrosive environments, shall be dipped in Zinc Chromate Primer before installation. Rods may be galvanized, or cadmium plated after threading, in lieu of dipping zinc chromate.
 - 2. All hangers and supports exposed to the weather, including roofs and building crawl space areas, shall be galvanized or manufactured from materials that will not rust or corrode due to moisture. All hangers and supports located within corrosive environments shall be constructed from or coated with materials manufactured for installation within the particular environment.
- R. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on manufactured channel, suspended on rods or pipes. Trapeze members including suspension rods shall be properly sized for the quantity, diameters, and loaded weight of the lines they are to support.
- S. Vertical Piping:
 - 3. Supports for vertical riser piping in concealed areas shall utilize double bolt riser clamps, with each end having equal bearing on the building structure at each floor level.
 - 4. Supports for vertical riser piping at floor levels in exposed areas (such as fire protection standpipe in stairwells) shall be attached to the underside of the penetrated structure utilizing drilled anchors, two hanger rods (sized as specified), and socket clamp with washers.
 - 5. Two-hole rigid pipe clamps or four-hole socket clamps with washers may be used to support pipe directly from adequate structural members where floor-to-floor distance exceeds required vertical support spacing and lines are not subject to expansion and contraction.

- T. Fixture and Equipment Service Piping:
1. Piping at local connections to plumbing fixtures and equipment shall be supported to prevent the weight of the piping from being transmitted to fixtures and equipment.
 2. Makeshift, field-devised methods of plumbing pipe support, such as with the use of scrap framing materials, are not allowed. Support and positioning of piping shall be by means of engineered methods that comply with IAPMO PS 42-96. These shall be Holdrite support systems, BASSET or Owner-approved equivalent.
 3. Supports within chases and partitions shall be corrosion resistant metal plate, clamps, angles or channels, and aligned with structure in the vertical or horizontal position. Plastic supports are not allowed unless approved by Owner.
 4. Horizontal supports within chases and partitions that are attached to studs shall be attached at both ends. Drywall shall not be relied upon to support the piping.
 5. Supports for plumbing fixture water service piping within chases and partitions may be attached to cast iron drain and vent pipe with approved brackets and pipe clamps.
 6. Piping exposed on the face of drywall shall be supported with corrosion resistant metal channels that are attached to wall studs. Drywall shall not be relied upon to support the piping.
 7. Piping supported from the floor shall utilize corrosion resistant metal channels or brackets that are anchored to the floor slab.

2.02 PIPE HANGERS AND SUPPORTS

- A. Plumbing Piping – DWV / Storm Drain:
1. Conform to ASTM F708, MSS SP58, MSS SP69, MSS SP89.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 7. Vertical Support: Steel riser clamp.
 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
 10. Crawl Space: Hangers and accessories shall be hot-dipped galvanized.
- B. Plumbing Piping – Water, Natural Gas, Medical Gases.

1. Conform to ASTM F708, MSS SP58, MSS SP69, MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron or Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
11. Vertical Support: Steel riser clamp at every floor.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
15. Copper Pipe Support: Copper-plated, Carbon-steel ring. Provide non-metallic coatings or inserts on attachments for electrolytic protection where attachments are in direct contact with copper piping.

2.03 ACCESSORIES

- A. Hanger Rods: Galvanized mild steel; threaded both ends, threaded on one end, or continuous threaded.
- B. Pipe Shields: Provide pipe shields at each support location of insulated piping in accordance with insulation manufacturer's published recommendations. Install MSS SP-58, Type 39 protection shields, if insulation without vapor barrier is indicated. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Refer to Section 22 07 00 for additional data on insulation shields.
- C. Concrete Inserts:
 1. Cast in place concrete inserts shall comply with MSS SP 69, U.L. and F.M. standards and shall be sized to suit threaded hanger rods.

2. Inserts shall have malleable iron case with galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
 3. Suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval.
 4. Manufactured inserts for metal deck construction shall have legs custom fit to rest in form valleys.
 5. Shop fabricated inserts shall be submitted and approved by Owner prior to installation.
 6. Inserts shall be of a type that will not interfere with structural reinforcing and that will not displace excessive amounts of structural concrete.
- D. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.
- E. Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

2.04 FLASHING

- A. Metal Flashing: 20 gage thick galvanized steel.
- B. Metal Counterflashing: 20 gage thick galvanized steel.
- C. Lead Flashing:
 1. Waterproofing: 5 lb./sq. ft sheet lead.
 2. Soundproofing: 1 lb./sq. ft sheet lead.
- D. Flexible Flashing: Compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.05 SLEEVES

- A. Sleeves for Pipes Through Non-Fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sealant: Refer to Section 07 90 00.
- D. Provide UL/FM or Warnock Hersey approved assembly for sleeves through fire rated floors or walls.

2.06 MECHANICAL SLEEVE SEALS

- A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.07 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12-gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1-5/8 inch by 1-5/8-inch minimum strut or stronger as required. with holes 1-1/2 inches on center.

2.08 EQUIPMENT BASES (HOUSEKEEPING PADS)

- A. Provide minimum 3-1/2-inch reinforced concrete pads with chamfered corners and equipment bases for all outdoor equipment on grade, floor mounted equipment in main central plant area, mechanical rooms, areas with floors below grade, penthouse equipment rooms, and where shown on Drawings.
- B. Refer to Section 03 30 00 for concrete requirements.
- C. Housekeeping pads shall extend minimum of 6 inches on all sides beyond the limits of the mounted equipment unless otherwise noted.
- D. Provide galvanized anchor bolts for all equipment placed on concrete pads or on concrete slabs of the size and number recommended by the equipment manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

3.02 PREPARATION

- A. Do not drill or cut structural members, unless written permission is obtained from the Structural Engineer.
- B. All auxiliary steel required for supports, anchors, guides, etc. shall be provided by the Contractor unless specifically indicated to be provided by others.
- C. All supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
- D. Contractor shall be responsible for structural integrity of all supports, anchors, guides, etc. All structural hanging materials shall have a minimum safety factor of 5 built in.

3.03 INSTALLATION – GENERAL

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having

jurisdiction.

- B. Application, sizing and installation of piping, supports, anchors and sleeves shall be in accordance with manufacturer's printed installation instructions.
- C. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc. All piping shall be installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.
- D. Install hanger so that rod is vertical under operating conditions.
- E. Provide for vertical adjustments after erection and during commissioning, where feasible, to ensure pipe is at design elevation and slope.
- F. Install hangers and supports to allow controlled thermal movement of piping systems, permitting freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Supports hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.
- H. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including any concrete that holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required. Contractor shall be responsible for engaging a structural engineer as required for design and review at support systems.
- I. Do not hang pipe or any plumbing item directly from a metal deck or locate on the bottom chord of any truss or joist unless approved by the Structural Engineer of Record.
- J. Piping supports shall be independent from ductwork supports and fire protection piping supports or supports for other trade. Combining supports is not permitted.
- K. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc.
- L. All piping supports shall be designed and installed to allow the insulation to be continuous through the hangers.
- M. Adjustable clevis hangers shall be supported at rods with a nut above and below the hanger.
- N. All hanger rods shall be trimmed neatly so that 1 inch of excess hanger rod protrudes beyond the hanger nut. In the event a rod is intentionally but temporarily left excessively long (for sloped or insulated lines for example), the Contractor shall take appropriate measures to protect the pipe or other materials from damage.
- O. Install hangers to provide minimum ½ inch space between finished covering and adjacent structures, materials, etc.

3.04 INSTALLATION – PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME 31.9, ASTM F708, MSS SP 69 and MSS SP 89.
- B. Support horizontal piping as scheduled at end of this section.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Locate hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor and at maximum 10' on center. Support vertical cast iron pipe at each floor and at each hub.
- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide non-metallic coatings or inserts on attachments for electrolytic protection where attachments are in direct contact with copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.
- N. Insulated piping larger than 2" diameter shall be supported with inserts of the same thickness as the insulation, or with other approved methods. Refer also to Section 22 07 00 – Piping Systems Insulation.
- O. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.
- P. Cast iron soil pipe 6 inches and smaller shall be supported at each joint, within 18 inches of joint. Cast iron soil pipe 8 inches and larger shall be supported on both sides of each joint when horizontal run exceeds five (5) feet.
- Q. Vent through roof pipe: Support vertical pipe through roof with riser clamp and vertical support members attached to structure. Support of pipe through roof shall not bear the weight on the no-hub coupling.
- R. Horizontal supports within chases and partitions that are attached to studs shall be attached at both ends. Supports shall not exceed four feet in length.

3.05 INSTALLATION – ATTACHMENT TO STRUCTURE

- A. Hangers shall be attached to the structure as follows.
1. Poured-In-Place Concrete: Where pipes and equipment are supported under poured in place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters Laboratories, Inc. listed universal concrete insert placed in the form work before concrete is poured. Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly or where a larger insert would require displacement of the bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I-beam, etc. spanning across two adjacent joists. The horizontal support shall be bolted to nonadjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.
 2. Pre-Cast Tee Structural Concrete: Hanger supports, anchors, etc. required for mechanical systems attached to the precast, double tee, structural concrete system are to be installed in accord with approved shop Drawings only. Holes required for hanger rods shall be core drilled in the "flange" of the double tee only; impact type tools are not allowed under any circumstances. Core drilling in the "stem" portions of the double tee is not allowed. Holes core drilled through the "flange" for hanger rods shall be no greater than 1/4" larger than the diameter of the hanger rod. Hanger rods shall be supported by means of bearing plates of size and shape acceptable to the Architect/Engineer, with welded double nuts on the hanger rod above the bearing plate. Cinch anchors, lead shields, expansion bolts, and studs driven by explosion charges are not allowed under any circumstances in the lower 15" of each stem and in the "shadow" of the stem on the top side of the "double tees".
 3. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods may be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.
 4. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.
 5. Wood Framing: Where pipes and loads are supported from wood framing, hanger rods shall be attached to framing with side beam brackets or angle clips.
- B. Concrete Inserts.
1. Install inserts for placement in concrete forms.
 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- C. Where inserts are omitted, drill through concrete slab from below and provide through-

bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.06 INSTALLATION – FLASHING

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal all drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.
- F. Coordinate all roof flashing with requirements of Division 07.

3.07 INSTALLATION – SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 2 inches above finished floor level. Caulk sleeves.
- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel or stainless-steel escutcheons at finished surfaces.
- G. Where installed in fire rated wall, floors, etc., install in accordance with UL/FM or Warnock Hersey fire rated assembly instructions.
- H. Install sleeves for all piping passing through penetrations in floors, partitions, roofs, and walls. All penetrations shall pass through sleeves.
- I. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls. Sleeves are not required for core-drilled holes.
- J. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -

PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- K. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants"

3.08 INSTALLATION – EQUIPMENT BASES AND SUPPORTS

- A. Provide concrete housekeeping pads, per requirements in Part 2 of this section.
- B. Install anchor bolts, and accessories for mounting and anchoring equipment. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of sufficient size to provide ½ inch clearance around bolt.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.09 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements, 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

3.10 CLEANING

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.12 SCHEDULE

PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING (Feet)	MIN. HANGER ROD DIAMETER (Inches)
Cast Iron, up to 2 inches	5	3/8
Cast Iron, 3 inches	5	1/2
Cast Iron, 4 inches	5	5/8
Cast Iron, 6 thru 8 inches	5	3/4
Cast Iron, 10 thru 12 inches	5	7/8
Copper Tube, 1-1/4 inches and smaller	6	3/8
Copper Tube, 1-1/2 thru 2-1/2 inches	8	1/2
Copper Tube, 3 inches and larger	10	5/8
PVC (All Sizes)	4	3/8
Steel Pipe, 1-1/2 inches and smaller	8	3/8
Steel Pipe, 2 thru 3 inches	10	1/2
Steel Pipe, 4 inches and larger	12	5/8

Support all vertical piping at each floor level and at maximum 10 feet spacing.

Support all cast iron piping at each floor level and at each hub or at each coupling on hubless pipe.

END OF SECTION

SECTION 22 05 53 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Equipment markers.
2. Valve tags.
3. Valve schedules.
4. Pipe markers.
5. Ceiling tacks.
6. Signs.
7. Detectable Underground Warning Tape.

B. Related Sections:

1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 – Scheme for the Identification of Piping Systems.

B. American National Standards Institute:

1. ANSI Z535.1 – Safety Color Standard.
2. ANSI Z535.2 – Environmental and Facility Safety Signs.

C. National Fire Protection Association:

1. NFPA 99 – Health Care Facilities Code.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Product Data: Submit manufacturer's catalog literature for each product required.

C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification. Submit a valve chart and schedule, including valve tag number, location, function and valve manufacturer's name and model number.

D. Manufacturer's Installation Instructions: Indicate installation instructions, special

procedures, and installation.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.05 QUALITY ASSURANCE

- A. Conform to ASME A13.1 and ANSI Z535.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ASME A13.1 for length of field and letter height for pipe markers.
- C. Conform to ANSI Z535.1 and ANSI Z535.2 for emergency operating information and warning signs.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years of experience.

PART 2 PRODUCTS

2.01 PIPE MARKERS

- A. General: Conform to ASME A13.1 for background and letter colors, length of color field and letter height.
- B. Self-Adhesive Pipe Markers: Flexible, indoor/outdoor grade vinyl with factory-applied pressure-sensitive adhesive. Provide with minimum 1-1/2 inch wide banding tape.
- C. Mechanically Applied Pipe Markers:
 - 1. For pipes with an overall diameter up to 6 inches, including insulation, provide semi-rigid plastic wrap around pipe marker that extends 360 degrees around the pipe at each marker location. The semi-rigid marker should include the legend and a directional flow arrow. Pipe size shall also be on label of all insulated pipes. The marker shall be supplied as a pre-tensioned device and be equipped with a 1/2 inch strip of adhesive on the inside to further secure the marker in a permanent position on vertical locations.
 - 2. For pipes with an overall diameter greater than 6 inches, including insulation, provide a semi-rigid plastic strap-on pipe marker with a height no less than 3 times the letter height. The marker shall include a legend and a directional flow arrow. Pipe size shall also be on label of all insulated pipes. Markers to be installed indoors shall be supplied with no less than two nylon straps to secure the marker

in place. Markers to be installed outdoors shall be supplied with stainless steel or aluminum strapping.

2.02 DIRECTIONAL ARROWS

- A. Flow Direction: Provide flow directional arrows either as part of pipe markers, banding tape or separately, attached to pipes.
 - 1. Conform to requirements for markers.
 - 2. Size to conform to ANSI A13.1 (1 inch wide minimum).

2.03 DETECTABLE UNDERGROUND WARNING TAPE

- A. Description: Polyethylene tape resistant to acids, alkalis and other destructive soil components with metallic core for detection and location of piping with metal detector. Tape shall be a minimum of 6 inches wide with a minimum thickness of 5 mils. Utilize manufacturer's standard legends to identify water lines, pipe lines, gas lines, fuel lines, steam lines and sewer lines. Provide a continuous printed message with bold black lettering similar to "Caution Buried Water Line Below." Tape color and lettering shall be unaffected by moisture and other substances contained in the backfill material. The tape color shall conform to the American Public Works Association Uniform Color Code.

2.04 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
 - 1. Green: Plumbing valves.

2.05 PLASTIC EQUIPMENT MARKERS

- A. General: Provide laminated plastic equipment markers for all scheduled items of plumbing equipment installed indoors.
- B. Size: Size laminated plastic markers not less than one inch in height and three inches in length with engraved lettering white on black not less than 1/4 inch in height. For larger pieces of equipment, size markers 1-1/2 inch in height by 4-1/2 inches long, of 3/32 inch laminated plastic melamine with white on black lettering engraved not less than 1/16 inch deep and 1/2 inch high.
- C. Attachment: Attach nameplates with rivets, stainless steel screws or bolts. On equipment such as tanks and pumps which cannot be drilled or pierced, attach nameplates with brass chains and "S" hooks.
- D. For plumbing equipment installed above ceiling, provide 3/4 inch by 2-1/2 inches laminate tags attached with rivets to the ceiling grid below.

2.06 ALUMINUM EQUIPMENT MARKERS

- A. General: Provide engraved anodized aluminum equipment markers for all scheduled items

of plumbing equipment installed outdoors.

- B. Size: Size engraved aluminum markers not less than 1 inch in height and 3 inches in length with engraved lettering white on black background not less than 5/8 inch in height. For larger pieces of equipment, size markers 3 inches in height by 6 inches long, with lettering not less than 1 inch in height.
- C. Attachment: Attach nameplates with rivets, stainless steel screws or bolts. On equipment such as tanks and pumps which cannot be drilled or pierced, attach nameplates with stainless steel chains and "S" hooks.

2.07 VALVE TAGS

- A. Materials: Provide indoor valve tags of solid brass with stamped or engraved lettering or numbers. Provide outdoor valve tags of aluminum with stamped or engraved lettering or numbers.
 - 1. Fill lettering and numbers with black paint.
 - 2. Lettering shall be not less than 1/4 inch in height.
 - 3. Numbers shall be not less than 1/2 inch in height.
- B. Attachment: For valve tags in mechanical rooms, provide with brass jack chain and "S" hook attachment. For all other indoor valve tags, provide with brass beaded chain attachment. For all outdoor valve tags, provide with stainless steel jack chain and "S" hook attachment.

2.08 ENGRAVED PLASTIC LAMINATE SIGNS

- A. General: Where indicated in other sections of the specifications, provide engraved instruction signs, warning signs, operational instructions or other signs designated.
- B. Emergency Operating Signs: For emergency operating instructions, provide engraved, laminate, melamine plastic, white on red, not less than 1/8 inch thick.
 - 1. Provide concise written instructions on the emergency operation of the device.
 - 2. Letters shall be not less than 5/16 inch in height, engraved 1/16 inch deep in block capital letters.
- C. Information and Warning Signs: Provide general information and warning signs of laminated, melamine plastic, not less than 1/8 inch thick, with white engraved lettering on black, with letters not less than 1/4 inch in height, block capitals.
- D. Attachment: Attach signs directly to the equipment with rivets, bolts or screws, if possible. Otherwise, attach signs with angle brackets, U-bolts, or metal plates held in place to piping with stainless steel draw-bands.
 - 1. Attachment with adhesives will not be permitted.
 - 2. Locate signs not less than 4 feet nor more than 6 feet above the operating floor,

directly visible from an operating aisle.

3. Locate signs to preclude damage during maintenance and repair or by operating traffic.

2.09 VALVE SCHEDULES AND FRAMES

- A. General: Provide valve schedules for all valves provided by Division 22.
- B. Schedules: Provide typed or machine printed schedules, one item per line, double spaced.
 1. Printing shall be black on 8-1/2-inch by 11-inch white paper. Paper shall be waterproof or laminated after printing.
 2. For each valve, list the valve number, location, size and use or operating function.
 3. Support schedules in full extruded aluminum frames with removable, non-yellowing, clear plastic faces.
 4. Screw or bolt schedules to equipment room walls where directed.
 5. Coordinate valve numbers with valve tags so that no two valves or scheduled devices have the same number.

PART 3 EXECUTION

3.01 GENERAL

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Install identifying devices after completion of coverings and painting.
- C. Install labels with sufficient adhesive for permanent adhesion. For unfinished canvas covering, apply paint primer before applying labels.

3.02 CONCEALED VALVES AND EQUIPMENT

- A. Equipment Above Ceilings: Provide valve tagging and identification to equipment located above ceilings, such as valves, trap primers and other items before the ceilings are installed.
- B. Finished Surfaces: Where identification is to be provided on surfaces which require insulation, painting and finishing, install identification after covering and painting is complete.
- C. Provide ceiling tacks to locate valves or equipment above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- D. Provide plastic nameplates adhered to the ceiling grid to locate valves, equipment, or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Label with tag of equipment.

3.03 PIPING SYSTEM IDENTIFICATION

- A. Install pipe markers on all piping systems and include arrows to show the normal direction of flow. Where flow can be in both directions, arrows in both directions shall be displayed.
- B. Identify piping exposed to view and concealed by accessible ceilings, including hard ceilings provided with access panels. Identify piping outdoors, in crawlspaces, on roof, above grade and within parking structures. Only piping located within walls or inaccessible areas need not be identified.
- C. Identify the temperature of domestic hot water piping systems, i.e. "140°F HOT WATER."
- D. Locate pipe markers as follows:
 - 1. Every 15 feet on straight runs.
 - 2. At each valve and control device.
 - 3. At each branch or take-off. Provide flow arrows on the branch pipe as well as on the main on both sides of the branch.
 - 4. At any change in piping direction.
 - 5. Above and below every floor or roof penetration.
 - 6. On either side of every wall or partition. Ensure there is a minimum of one marker per pipe in every room.
 - 7. On either side of large obstructions, ductwork or equipment that piping passes above.
 - 8. At 5-foot intervals where piping is obscured by close proximity to walls or other pipes.
 - 9. Provide only one label per unit drain connection for condensate drain piping on roof.
- E. Install pipe markers so they are visible and legible from a normal standing position.
- F. Secure each end of self-adhesive pipe markers with a full wrap of banding tape of the same background color. Banding tape shall overlap itself a minimum of 3 inches.
- G. Provide mechanically applied pipe markers for all piping in mechanical rooms and outdoors.
- H. Install detectable underground warning tape 12 inches below finished grade, directly above buried pipe. If piping is buried more than 36 inches below finished grade, then provide an additional continuous length of tape buried 12 inches above the piping.

3.04 VALVE IDENTIFICATION

- A. General: Provide a valve tag on every valve, cock and control device in each piping system.

Exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs and shut-off valves at plumbing fixtures. List each tagged valve in valve schedule for each piping system. In existing buildings, coordinate valve tags and schedules such that no valve numbers are duplicated.

1. Tagging Schedule: Comply with requirements of "Valve Tags" and "Valve Schedules and Frames" paragraph.
- B. Install valve schedule frames and schedules in machine rooms where indicated or where directed.

3.05 PLUMBING EQUIPMENT IDENTIFICATION

- A. General: Install equipment markers on or near each major item of plumbing equipment. Provide signs for the following general categories of equipment and operational devices:
1. Main control and operating valves.
 2. Meters and gauges.
 3. Fuel-burning units including boilers and water heaters.
 4. Pumps, compressors and motor-driven units.
 5. Heat exchangers.
 6. Primary balancing valves.
 7. Packaged booster pump units.
 8. Tanks and pressure vessels.
 9. Filters and water treatment systems.
- B. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

3.06 COLOR AND IDENTIFICATION SCHEDULE

A. Provide all pipe labels and lettering of colors listed below.

<u>FLUID SERVICE TYPE</u>	<u>PIPE MARKER LEGEND</u>	<u>PIPE MARKER BACKGROUND / LETTERING COLOR</u>	<u>VALVE TAG LETTERING</u>
Domestic Cold Water	COLD WATER	Green / White	CW
Domestic Hot Water - 115°F	115°F HOT WATER	Green / White	HW
Domestic Hot Water Recirculation - 115°F	115°F HOT WATER RETURN	Green / White	HWC
Sanitary Waste	SANITARY WASTE	Green / White	
Sanitary Vent	SANITARY VENT	Green / White	
Storm or Roof Drain	STORM DRAIN	Green / White	
Natural Gas	NATURAL GAS	Yellow / Black	GAS

B. For medical gas piping, provide pipe labels and lettering of colors of color listed below:

<u>FLUID SERVICE TYPE</u>	<u>PIPE MARKER LEGEND</u>	<u>PIPE MARKER BACKGROUND / LETTERING COLOR</u>	<u>VALVE TAG LETTERING</u>
Oxygen	OXYGEN	Green / White	O2
Non-Medical Vacuum	NON MEDICAL VACUUM	White & Black Stripe / Black	VAC
Non-Medical Air	NON MEDICAL AIR	White & Yellow Stripe / Black	AIR
Nitrous Oxide	NITROUS OXIDE	Blue / White	N2O

END OF SECTION

SECTION 22 07 00 – PLUMBING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Adhesives, mastics and sealants.
2. Piping – Glass Fiber.
3. Piping – Jackets.
4. Cellular Foam.
5. Insulation Shields and Inserts.
6. Plenum wrap.

B. Related Sections:

1. Section 07 84 00 – Firestopping: Product requirements for firestopping for placement by this section.
2. Section 09 90 00 – Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.
3. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment: Product and Execution requirements for inserts at hanger locations.
4. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

1.02 REFERENCES

A. ASTM International:

1. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM C177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
4. ASTM C195 – Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449/C449M – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C518 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter

Apparatus.

7. ASTM C533 – Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
8. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
9. ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation.
10. ASTM C552 – Standard Specification for Cellular Glass Thermal Insulation.
11. ASTM C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
12. ASTM C591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
13. ASTM C592 – Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
14. ASTM C610 – Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
15. ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
16. ASTM C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
17. ASTM C921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
18. ASTM C1126 – Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
19. ASTM C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
20. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
21. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
22. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
23. ASTM E162 – Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
24. ASTM G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

B. Greenguard Environmental Institute:

1. GEI - Greenguard Certification Standards for Low-Emitting Products.

- C. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 – Adhesive and Sealant Applications, including all amendments through October 2017
 - a. PVC welding: Maximum VOC content 510 g/L.
 - b. Adhesive primer for plastic: Maximum VOC content 550 g/L.
 - c. Contact adhesive: Maximum VOC content 80 g/L.
 - d. Fiberglass adhesive: Maximum VOC content 80 g/L.
 - e. Insulation joint sealant: Maximum VOC content 420 g/L.
 - f. Other: Maximum VOC content 420 g/L.
- D. Green Seal Standard GS-11
 - 1. GS-11 – Paints and Coatings (flat insulation coatings); Edition 3.2, October 2015.
 - a. Vapor Barrier Coatings: Maximum VOC content 50 g/L.
 - b. Weather Barrier Mastics: Maximum VOC content 50 g/L.
 - c. Lagging Adhesive/Coating: Maximum VOC content 50 g/L.

1.03 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers published literature for each type of insulation. Data shall include product description, thermal characteristics, moisture absorption rating, flame spread and smoke developed ratings for each product.
- C. Submittal shall include a schedule indicating the following for each type of insulation:
 - 1. Pipe system
 - 2. Location (interior, exterior, mechanical room, etc.)
 - 3. Insulation and jacketing material
 - 4. Fitting insulation and jacketing material
 - 5. Pipe size range
 - 6. Insulation thickness
- D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature during and after installation for minimum period of 24 hours.

1.07 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 ADHESIVES, MASTICS AND SEALANTS

- A. All adhesives, mastics and sealants utilized for pipe insulation shall have a maximum VOC content as specified in Part 1 of this Section

2.02 PIPING – GLASS FIBER

- A. Insulation: ASTM C547; rigid molded, non-combustible.
 - 1. 'K' value: ASTM C335, 0.24 at 75°F.
 - 2. Service Temperature: -20°F. to 300°F.
 - 3. Maximum Moisture Absorption: 0.2% by volume.
 - 4. Maximum Flame Spread: ASTM F84:25.
 - 5. Density: 2.5 lbs./cu.ft., minimum.
 - 6. Maximum Smoke Developed: ASTM E84:50.
- B. Vapor Barrier Jacket
 - 1. ASTM C921, white kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 - 2. Water Vapor Permeability: ASTM E96; 0.02 perms-inches.
 - 3. Secure with self sealing longitudinal laps and butt strips.

4. Secure with outward clinch expanding staples and vapor barrier mastic.
- C. Tie Wire: 18 gage stainless steel with twisted ends on maximum 12 inch centers.
- D. Vapor Barrier Lap Adhesive
 1. Compatible with insulation.
- E. Insulating Cement/Mastic
 1. ASTM C195; hydraulic setting on mineral wool.
- F. Fibrous Glass Fabric
 1. Cloth: Untreated; 9 oz/sq. yd. weight.
 2. Blanket: 1.0 lb./cu. ft. density.
- G. Indoor Vapor Barrier Finish
 1. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.03 PIPING – JACKETS

- A. PVC Plastic
 1. Jacket: ASTM C921, One piece molded type fitting covers and sheet material, off white color.
 - a. Service Temperature: -40°F. to 150°F.
 - b. Water Vapor Permeability: ASTM E96; 0.002 perms-inches.
 - c. Maximum Flame Spread: ASTM E84; 25.
 - d. Maximum Smoke Developed: ASTM E84; 50.
 - e. Thickness: 20 mil.
 - f. Connections: Brush on welding adhesive.
 2. Covering Adhesive Mastic
 - a. Compatible with insulation.
- B. Aluminum Jacket: ASTM B209.
 1. Thickness: 0.016 inch.
 2. Finish: Smooth.
 3. Joining: Longitudinal slip joints and 2 inch laps.
 4. Fittings: 0.016 mm thick die shaped fitting covers with factory attached protective liner.
 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.04 CELLULAR FOAM

- A. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - 1. 'K' Value: ASTM C177 or C518; 0.27 at 75°F.
 - 2. Service Temperature: -40°F. to 220 degrees F.
 - 3. Maximum Moisture Absorption: ASTM D1056; 1.0% by volume.
 - 4. Water Vapor Permeability: ASTM E96; 0.20 perms-inches.
 - 5. Maximum Flame Spread: ASTM E84; 25.
 - 6. Maximum Smoke Developed: ASTM E84; 50.
 - 7. Connection: Waterproof vapor barrier adhesive.
- B. Elastomeric Foam Adhesive
 - 1. Air dried, contact adhesive, compatible with insulation.

2.05 INSULATION SHIELDS AND INSERTS

- A. Insulation Shields:
 - 1. Application: All insulated piping, except for below grade direct buried piping.
 - 2. Shields shall be made of galvanized steel or made of black iron painted on both sides with a minimum two coats of aluminum paint. Minimum metal shield sizes shall be as listed within the following table. Provide thicker/longer shields where recommended by insulation manufacturer's published product installation data:

Nominal IPS (inches)	Minimum Metal Thickness (gage)	Minimum Length (inches)
1/2 to 1-1/4	18	12
1-1/2 to 2	16	12
2-1/2 to 8	14	18
10	12	24

- 3. Provide MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier.
 - 4. Depending on the type of pipe support design, stainless steel bands or aluminum bands may be required to keep shield material next to the jacketing material.
 - a. Insulation Bands: 3/4 inch wide; 0.007 inch thick galvanized steel when exposed to interior environment, 0.010 inch thick stainless steel or 0.015 inch thick aluminum when exposed to humid interior environment or outside environment.
 - b. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel to match jacket.
- B. Insulation Inserts:

1. Application: All insulated piping larger than 2-inch diameter, except for below grade direct buried piping.
2. Inserts for shields shall be manufactured of corrosion resistant insulating material; cellular glass, phenolic or polyisocyanurate, of minimum 5.0 lb/cu. ft. density, suitable for the planned temperature range.
3. Inserts shall be the same thickness and contour as the adjacent insulation and shall be at least as long as the metal shield.
4. Factory fabricated inserts with integral galvanized pipe shields will be acceptable.

2.07 PLENUM WRAP

- A High-temperature fiber blanket thermal insulation encapsulated in fiber glass-reinforced aluminized foil. Plenum wrap shall be a nominal 6 PCF and have a nominal 1/2" thickness. The fiber blanket shall have a continuous use limit in excess of 1832°F. Flame Spread Index and Smoke Developed Index of the foil encapsulated blanket shall be 25/50, respectively.
- B Min. 3/4 in. wide Scotch® Filament Tape 898 (or equivalent),
- C 3M™ FSK Facing Tape 3320 (or equivalent),
- D Min. 1/2 in. wide x min. 0.015 in. thick carbon steel or stainless steel banding material with steel banding clips or 16 gauge steel tie wire as alternate for banding, banding tensioner, crimping tool, and banding cutter.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify piping and equipment has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.02 COMMON INSULATION REQUIREMENTS

- A. Insulation shall not be installed until all testing and inspection of pipe, vessel, etc. has been completed and approved by Engineer/Owner's representative.
- B. Replace insulation damaged by either moisture or other means. Insulation which has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also replace any materials damaged by the condensation.
- C. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

- D. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- E. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- F. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- G. Install multiple layers of insulation with longitudinal and end seams staggered.
- H. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- I. Keep insulation materials dry during application and finishing.
- J. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- K. Install insulation with least number of joints practical.
- L. Install insulation continuously through hangers and sleeves and around anchor attachments.
- M. Where penetrating fire and/or smoke rated walls, partitions, barriers, or floors, provide UL-approved pipe and duct penetration assemblies that maintain the rating of the penetrated wall, partition, barrier, or floor.
- N. Insulation on all pipes conveying liquids below the ambient temperature is required to have a continuous vapor barrier. On all insulation with a vapor barrier, seal the joints, duct wrap seams, vapor retarder (ASJ) film seams and penetrations in insulation at hangers, supports, anchors, and other projections with a vapor-barrier coating/mastic as specified in the individual insulation sections.
 - 1. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier coating/mastic.
 - 2. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 3. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

3.03 PAINTING OF INSULATION

- A. Where indicated on the construction documents, paint piping insulation in exposed areas, not including mechanical and equipment rooms. Do not paint insulation located in return air plenums.

- B. Prior to painting, wipe insulation jacket clean with a mild cleaning solution that will not leave a residue and allow to dry completely. Paint jacket with water based (latex) paint in accordance with manufacturer's recommendations and as required in the specification Section 09 90 00 Painting and Coating.

3.04 INSTALLATION – PIPE INSULATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- D. Insulated pipes conveying fluids below ambient temperature:
 - 1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- E. Insulated pipes conveying fluids above ambient temperature:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
- F. Provide neck extensions or extended stems for valves installed in insulated lines. Refer to Section 22 11 00.
- G. Insulation Shields and Inserts:
 - 1. Application: Provide shields for all insulated piping, except for below grade direct buried piping. Provide insulation inserts for all piping or equipment larger than 2-inch diameter.
 - 2. Shields: Install between pipe hangers, pipe supports or pipe hanger rolls and inserts.
 - 3. Insert location: Install between support shield and piping and under finish jacket.
- H. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- I. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers or aluminum jacket.

- J. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.
- K. Heat Traced Piping: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.
 - 1. Refer to Section 22 11 00 for heat tracing.

3.05 INSTALLATION – PLENUM WRAP

- A. Install a plenum wrap insulation system on all plastic piping within a return air plenum that carries a flame spread rating over 25 or a smoke developed rating over 50, when tested in accordance with ASTM E84.
- B. The plenum wrap system shall be installed by a qualified contractor in accordance with the manufacturer's instructions.
- C. Cut the plenum wrap to a length sufficient to wrap completely around the perimeter of the pipe with an overlap of at least 1".
- D. Aluminum foil tape shall be utilized to seal cut edges of the blanket.
- E. Secure the blanket in place temporarily with glass filament tape, until banding or tie wire is in place.
- F. Install the next adjacent section of wrap with a minimum longitudinal overlap of 1"/
- G. Provide steel banding or tie wire around entire perimeter of insulated pipe at maximum 11" centers and 1/2" from each blanket edge. Tighten the banding or tie wire to hold wrap firmly in place without cutting or damaging the wrap.

3.06 PIPING – GLASS FIBER INSULATION SCHEDULE

	PIPING SYSTEMS	PIPE SIZE		THICKNESS
		Inches	Inches	
A.	Domestic Water:			
	Hot Water (105° to 140°F)	1-1/4" & smaller		1"
		1-1/2" & larger	1-1/2"	
	Hot Water (141° to 180°F)	1-1/4" & smaller		1-1/2"
		1-1/2" & larger	2"	
	Hot Water Return/Circulating	1-1/4" & smaller		1"
		1-1/2" & larger		1-1/2"
	Cold Water	ALL		1/2"
B.	Storm Drain:			
	Horizontal piping from roof drains and overflow drains (including underside of drain bodies)	ALL		1"

3.07 PIPING – CELLULAR FOAM INSULATION SCHEDULE

A.	Sanitary Drain:			
	Above floor piping receiving condensate from AC equipment. (Insulate drain body, trap, trap arm, tailpiece, and 20 ft of pipe vertical and horizontal and/or when it ties into the main.)	ALL		1"

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- A. See Specification 01 9113 General Commissioning Requirements.

END OF SECTION

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SECTION 22 11 00 – FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Domestic water piping, below grade.
2. Domestic water piping, above grade.
3. Unions and flanges.
4. Valves.
5. Pipe hangers and supports.
6. Pressure gauges and taps.
7. Thermometers.
8. Flow control valves.
9. Relief valves.
10. Strainers.
11. Hose bibs and hydrants.
12. Water meters.
13. Recessed valve box.
14. Backflow preventers.
15. Water hammer arrestors.
16. Thermostatic mixing valves.
17. Diaphragm-type compression tanks.
18. In-line circulator pumps.
19. Di-electric connections.
20. Trap primers.
21. Thermowells.

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete: Execution requirements for placement of concrete house keeping pads specified by this section.
2. Section 07 84 00 – Firestopping: Product requirements for firestopping for placement by this section.
3. Section 08 31 13 – Access Doors and Frames: Product requirements for access doors for placement by this section.
4. Section 22 00 01 – General Plumbing Requirements.
5. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports for placement by this section.
6. Section 22 05 53 – Identification for Plumbing Piping and Equipment: Product requirements for pipe identification and valve tags for placement by this section.
7. Section 22 07 00 – Plumbing Insulation: Product and execution requirements for pipe insulation.
8. Section 26 05 03 – Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.22 – Relief Valves for Hot Water Supply Systems.
2. ANSI/NSF 61 – Drinking Water Components – Health Effects.
3. NSF/ANSI 14 – Plastic Piping System Components and Related Materials

B. American Society of Mechanical Engineers:

1. ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.
2. ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
3. ASME B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes.
4. ASME B31.9 – Building Services Piping.
5. ASME B40.1 – Gauges - Pressure Indicating Dial Type - Elastic Element.
6. ASME Section VIII – Boiler and Pressure Vessel Code - Pressure Vessels.
7. ASME Section IX – Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. American Society of Sanitary Engineering:

1. ASSE 1010 – Performance Requirements for Water Hammer Arresters.
2. ASSE 1011 – Performance Requirements for Hose Connection Vacuum Breakers.
3. ASSE 1012 – Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
4. ASSE 1013 – Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
5. ASSE 1017 – Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems.
6. ASSE 1019 – Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
7. ASSE 1070 – Performance Requests for Water Temperature Limiting Devices.

D. ASTM International:

1. ASTM A182 – Standard Specification for Forged or Rolled Alloy and Stainless-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
2. ASTM A269 – Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
3. ASTM A276– Standard Specification for Stainless Steel Bars and Shapes.
4. ASTM A312– Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless-Steel Pipes.
5. ASTM B32 – Standard Specification for Solder Metal.
6. ASTM B42 – Standard Specification for Seamless Copper Pipe, Standard Sizes.
7. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
8. ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Applications.
9. ASTM E1 – Standard Specification for ASTM Thermometers.
10. ASTM E77 – Standard Test Method for Inspection and Verification of Thermometers.
11. ASTM F708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.

12. ASTM F1476 – Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.
 13. ASTM D2765 – Standard Test Method for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
 14. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
 15. ASTM E119 – Standard Test Methods for Fire Tests of Building Construction and Materials
- E. American Welding Society:
1. AWS A5.8 – Specification for Filler Metals for Brazing and Braze Welding.
- F. American Water Works Association:
1. AWWA C651 – Disinfecting Water Mains.
 2. AWWA C700 – Cold-Water Meters - Displacement Type, Bronze Main Case.
 3. AWWA C701 – Cold-Water Meters - Turbine Type, for Customer Service.
 4. AWWA C702 – Cold-Water Meters - Compound Type.
 5. AWWA C706 – Direct-Reading, Remote-Registration Systems for Cold-Water Meters.
 6. AWWA M6 – Water Meters – Selection, Installation, Testing and Maintenance.
 7. AWWA M14 – Backflow Prevention and Cross-Connection Control.
- G. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 – Pipe Hangers and Supports – Materials, Design and Manufacturer.
 2. MSS SP 67 – Butterfly Valves.
 3. MSS SP 69 – Pipe Hangers and Supports – Selection and Application.
 4. MSS SP 70 – Cast Iron Gate Valves, Flanged and Threaded Ends.
 5. MSS SP 71 – Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 6. MSS SP 78 – Cast Iron Plug Valves, Flanged and Threaded Ends.
 7. MSS SP 80 – Bronze Gate, Globe, Angle and Check Valves.
 8. MSS SP 85 – Cast Iron Globe & Angle Valves, Flanged and Threaded.
 9. MSS SP 89 – Pipe Hangers and Supports – Fabrication and Installation

Practices.

10. MSS SP 110 – Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- H. National Electrical Manufacturers Association:
1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- I. Plumbing and Drainage Institute:
1. PDI WH201 – Water Hammer Arrester Standard.
- J. Plastic Pipe Institute
1. PPI TR-3 / 2007 – Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe
- K. Underwriters' Laboratories
1. ANSI/UL 263 – Standard Fire Tests of Building Construction and Materials

1.03 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal procedures.
- B. Product Data:
1. Piping: Submit data on pipe materials, fittings and accessories. Submit manufacturer's catalog information and pipe joining methods: Solder, primer and glue, brazing, etc.
 2. Valves: Submit manufacturer's catalog information with valve data and ratings for each service.
 3. Hangers and Supports: Submit manufacturer's catalog information including load capacity.
 4. Domestic Water Specialties: Submit manufacturer's catalog information, component sizes, rough-in requirements, service sizes, and finishes.
 5. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

- E. Shop Drawings of water system.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves and equipment.
- C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.
- D. Record actual locations of valves, etc. and prepare valve charts.
- E. Test reports and inspection certification for all systems listed herein.
- F. Provide a certificate of completion detailing the domestic water system chlorination procedure and all laboratory test results.
- G. Submit location of access panels which vary from quantities or locations indicated on Contract Drawings.
- H. Provide full written description of manufacturer's warranty.
- I. Backflow preventer test report.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years of documented experience.
- C. Backflow prevention assembly tester shall be licensed by the State of Texas.

1.06 QUALITY ASSURANCE

- A. All work shall be in accordance with Texas Commission on Environmental Quality (TCEQ) Chapter 290 – Public Drinking Water.
- B. All piping materials shall be manufactured and tested according to applicable ANSI, ASTM, ASME, AWWA and CISPI standards.
- C. Unless otherwise noted, all piping materials shall be domestically manufactured in the USA.
- D. Piping Systems Materials:
 - 1. Note: Piping systems shall use consistent materials throughout each system. Materials for each piping system shall not be "mixed". Exception: where required due to above/below grade conditions; allowed due to inside building/outside building conditions; or where indicated by drawings or specifications.

2. Note: Lead containing solders shall not be used at any place in any system.
 3. All domestic water piping, fittings, valves and appurtenances shall be certified to ANSI/NSF 61.
- E. Manufacturer's name and pressure rating shall be permanently marked on valve body.
- F. The Contractor shall notify the manufacturer's representative prior to installing any copper press fittings. The Contractor shall obtain the representative's guidance in any unfamiliar installation procedures. The manufacturer's representative of copper press fittings shall conduct periodic inspections of the installation and shall report in writing to the Contractor and Owner of any observed deviations from manufacturer's recommended installation practices.
- G. Manufacturer Qualifications: Company shall have minimum three years documented experience specializing in manufacturing the products specified in this section.
- H. All grooved joint couplings, fittings, flanges, valves, and specialties of the same type shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- I. Installer Qualifications:
1. Company shall have minimum three years documented experience specializing in performing the work of this section.
 2. Installation of plumbing systems shall be performed by individuals licensed by the Texas State Board of Plumbing Examiners as a Journeyman or Master Plumber. Installation may be performed by Apprentice Plumbers provided they are registered with the Texas State Board of Plumbing examiners and under direct supervision of a licensed plumber. All installation shall be supervised by a licensed Master Plumber.
 3. All installers of copper press fittings shall be trained by the fitting manufacturer's appointed representative. Written notification of training shall be submitted to Owner prior to any installation.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
- B. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

- F. Store piping and equipment in a safe place, dry, enclosed, under cover in a well-ventilated area.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish 1-year manufacturer warranty for domestic water piping.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish 1 packing kit for each size valve, 1 loose key for outside hose bibs, service kits for 1 pump seal for each pump model.

PART 2 PRODUCTS

2.01 DOMESTIC WATER PIPING – BELOW GRADE

- A. Copper Tubing: ASTM B88, Type K, annealed.
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: Brazed, AWS A5.8, lead free, BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- B. Copper Tubing: ASTM B42, annealed.
 - 1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F. or Braze, AWS A5.8 lead free, BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- C. Buried pressurized piping sizes 2" and smaller shall be type "K" soft copper. No joints shall be allowed below slab.
- D. Building service riser: Riser shall be composed of a single extended 90-degree fitting of

fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a flanged connection on the inlet (building) side and a CIPS coupler on the inlet (underground) side. Riser shall be equivalent to Ames Fire & Waterworks Series IBR In-Building Riser.

2.02 DOMESTIC WATER PIPING – ABOVE GRADE

- A. Copper Tubing: ASTM B88, Type L, hard drawn.
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F. or Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
 3. Thread fitting: Pipe joint compound shall be lead free, non-toxic, low VOC and ANSI/NSF6/compliant. Temperature service range 10°F to 300°F.
 4. Press fittings: At contractor's option, copper piping 2 inch and smaller may be joined using copper or copper alloy press fittings with factory installed sealing elements of EPDM material.
- B. Polypropylene Piping: At contractor's option, polypropylene piping meeting requirements of Section 22 11 17 may be utilized for above ground domestic water piping.
- C. Buried pressurized piping sizes 2" and smaller shall be type "K" soft copper. No joints shall be allowed below slab.
- D. Building service riser: Riser shall be composed of a single extended 90-degree fitting of fabricated 304 stainless steel tubing, maximum working pressure 200 psi. The fitting shall have a flanged connection on the inlet (building) side and a CIPS coupler on the inlet (underground) side. Riser shall be equivalent to Ames Fire & Waterworks Series IBR In-Building Riser.

2.03 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
1. Ferrous Piping: Class 150, malleable iron, threaded.
 2. Copper Piping: Class 150, bronze unions with [soldered] [brazed joints].
 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 2. Copper Piping: Class 150, slip-on bronze flanges.

2.04 GATE VALVES

- A. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, ASTM B584, bronze trim, non-rising stem, hand-wheel, inside screw, solid wedge disc.
- B. 2-1/2 inches and Larger: MSS SP 70, Class 125, ductile iron body, stainless steel and bronze trim, bolted bonnet, non-rising stem, hand-wheel, outside screw and yoke or square operating nut (for underground applications), resilient solid wedge disc with bronze seat rings, and flanged ends.
 - 1. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.
 - 2. Underground valves provide valve stem extension. Provide bonnet box and louver; bonnet box extension and S.S. centering ring.

2.05 GLOBE VALVES

- A. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, threaded bonnet, hand wheel, Buna-N composition discs.

2.06 BALL VALVES

- A. 2 inches and Smaller: MSS SP 110, Class 150, bronze, two-piece body, chrome-plated bronze ball, full port, Teflon seats, blow-out proof stem, locking lever handle with balancing stops.
- B. Neck Extensions: Provide valves with extended round stem/necks where valves are installed in piping to be insulated. Stem/necks must permit operation of valve without damage to the insulation vapor barrier system. Nibco Nibseal or equal.

2.07 BUTTERFLY VALVES

- A. 2 inches and Larger: MSS SP 67, Class 150, AWWA C-504, Lead Free.
 - 1. Body: Ductile iron, lug ends, stainless steel stem, extended neck.
 - 2. Disc: stainless steel.
 - 3. Seat: Resilient replaceable Buna N.
 - 4. Handle and Operator: 10 position lever handle.

2.08 CHECK VALVES

- A. Horizontal Swing Check Valves:
 - 1. 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc.
 - 2. 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast-iron disc, renewable disc seal and seat, flanged ends.

B. Spring Loaded Check Valves:

1. 2 inches and Smaller: MSS SP 80, Class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat.
2. 2-1/2 inches and Larger: MSS SP 71, Class 125, wafer style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends.

2.09 PRESSURE GAUGES AND TAPS

- A. Gauges shall comply with ASME B40.1, Grade 2A, and have ± 0.5 percent of full-scale accuracy, with type 304 stainless steel or aluminum case, bronze wetted parts and brass socket. Dial face shall be 3½" diameter where installed within eight feet of floor level and 6" diameter where installed higher than eight feet above floor level. Dial face shall be aluminum with white background, black graduations and black markings. Pointer shall be adjustable with black finish. Provide remote read-out gauges for isolated or hard to access monitoring points.
- B. Units of measure shall be in pounds per square inch (psi). The proper range shall be selected so that the average operating pressure falls approximately in the middle of the scale selected.
- C. All pressure gauges shall be equipped with brass or stainless-steel needle valves and pressure snubbers.
- D. Pressure Gauge Taps:
 1. Needle Valve: Brass or stainless steel, 1/4-inch NPT for minimum 300 psi.
 2. Ball Valve: Brass or stainless steel 1/4-inch NPT for 250 psi.
 3. Pulsation Damper: Pressure snubber, brass or stainless steel with 1/4-inch (6 mm) NPT connections.

2.10 STEM TYPE THERMOMETERS

- A. Thermometers shall be vapor or liquid actuated, direct-mounted, universal adjustable angle dial type with stainless steel or cured polyester powder coated cast aluminum case, stainless steel friction ring and glass window. Dial face shall be white with black figures; pointer shall be friction adjustable type. Movement shall be brass with bronze bushings. Bourdon tube shall be phosphor bronze with a brass socket.
- B. Thermometer range shall be 30 - 240° Fahrenheit and have an accuracy of ± 1 scale division.
- C. Dial face shall be 4½" diameter where installed within eight feet of floor level and 6" diameter where installed higher than eight feet above floor level. Provide remote read-out gauges for isolated or hard to access monitoring points.
- D. Provide a brass or stainless steel separable thermowell for each thermometer.

- E. Thermometers shall have a sensing bulb with an insertion length of roughly half of the pipe diameter; minimum insertion length shall be 2". Thermometers installed on tanks shall have a minimum insertion length of 5".
- F. Where insulation thickness exceeds 2", provide proper bulb length and an extension neck thermowell at least 2" long.

2.11 FLOW CONTROL VALVES

- A. Construction: Class 150, Brass or bronze body, temperature and pressure test plug on inlet, combination blow-down or back-flush drain.
- B. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 5 psi.

2.12 RELIEF VALVES

- A. Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
- B. Temperature and Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, capacity ASME certified and labeled.

2.13 STRAINERS

- A. 2 inch and Smaller: Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- B. 2-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen.
- C. 5 inch and Larger: Class 125, flanged iron body, basket pattern with 1/8-inch stainless steel perforated screen.

2.14 HOSE BIBS AND HYDRANTS

- A. Manufacturers:
 - 1. Chicago.
 - 2. T&S.
 - 3. MIFAB.
 - 4. Zurn.

- B. Refer to Plumbing Miscellaneous Schedule on Project Drawings.

2.15 WATER METERS

- A. The water meters shall utilize velocity-type flow measurement, evenly distributed past impeller in measuring chamber to register totalized flow. Register assembly shall be removable under line pressure. Meters shall be furnished with permanently sealed registers (indicating flow in U.S. gallons), polymer basket strainer and direct magnetic drive.
- B. Meters shall fully conform to AWWA standard C-780 and shall NSF/ANSI Standard 61 certified with no lead main case.
- C. The water meters shall be rated for use at maximum temperature of 120 degrees F and at a maximum working pressure of 150 psig. Cold water meters shall be 3/4 inch and rated for a continuous flow of 20 gpm. Hot water meters shall be 5/8 inch and rated for a continuous flow of 15 gpm.
- D. Meters shall be equivalent to Master Meter "Bottom Load Multi-Jet" Meters.

2.16 BACKFLOW PREVENTERS

- A. All potable water systems shall be installed to prevent contamination from non-potable liquids, solids or gases through cross connection or any other connection to the system. Provide backflow prevention devices to serve all connections to non-potable water systems.
- B. Provide vacuum breakers for all elements or systems requiring vacuum breakers for code, function, and/or protection of equipment/systems. These locations shall include, but not necessarily be limited to service/janitor/mop sinks, etc.
- C. All backflow prevention devices and assemblies shall be tested and listed by University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCC&HR) or other agency approved by Texas Commission on Environmental Quality (TCEQ).
- D. Backflow preventer types. Provide the correct backflow preventer for each hazard.
 - 1. Double check valve type backflow preventer valve assemblies shall prevent the reverse flow of polluted water from entering into the potable water supply. Double check valve backflow prevention devices shall be used at low hazard sources of contamination where no potential health risks exists.
 - 2. Reduced pressure zone (RPZ) type backflow preventer valve assemblies shall prevent the reverse flow of polluted water from entering into the potable water supply due to backsiphonage and or backpressure. Reduced pressure zone backflow prevention devices shall be used at high hazard sources of contamination where a potential health risk exists and for containment at the water service entrance.
- E. Reduced Pressure Backflow Preventers:

1. Comply with ASSE 1013.
 2. Bronze body, with bronze internal parts and stainless-steel springs.
 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with two gate valves, strainer, and four test cocks.
- F. Double Check Valve Assemblies: Comply with ASSE 1012; Bronze body with corrosion resistant internal parts and stainless-steel springs; two independently operating check valves with intermediate atmospheric vent.

2.17 WATER HAMMER ARRESTORS

- A. ASSE 1010: Copper construction, piston type sized in accordance with PDI WH-201.
- B. Pre-charged suitable for operation in temperature range -100 to 300 degrees F and maximum 150 psi working pressure.
1. Bellows Type
 2. Piston Operated

2.18 THERMOSTATIC MIXING VALVES

- A. Mechanical Mixing Valve:
1. Valve: Chrome-plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment. ASSE 1017 listed.
 2. Capacity: Refer to Plumbing Equipment Schedule on project Drawings.
 3. Accessories:
 - a. Check valve on inlets.
 - b. Volume control shut-off valve on outlet.
 - c. Stem thermometer on outlet and inlets.
 - d. Strainer stop checks on inlets.
- B. Point of use mixing valve. Thermostatic mixing valve shall have body of brass or bronze with paraffin based thermal actuation. Valve shall be complete with integral checks with screens, and an adjustment cap with locking feature. Valve shall be ASSE Standard 1070 listed and shall maintain control down to 0.5 gpm. Valve shall maintain a mixed water temperature from 80° to 120°F ± 3°F. Set to deliver 110°F (unless indicated otherwise). Valve shall be capable of controlling mixed temperature while hot supply temperature ranges from 120°F to 180°F and withstand a maximum pressure of 150 psi. The minimum required differential between entering cold and hot water and mixed water shall be 15°F or lower.

2.19 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers and Capacity: Refer to plumbing schedules.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.

2.20 IN-LINE CIRCULATOR PUMPS

- A. Casing: Bronze rated for 125 psig working pressure with stainless steel rotor assembly.
- B. Impeller: Bronze.
- C. Shaft: Alloy steel with integral thrust collar and two, oil lubricated bronze sleeve bearings.
- D. Seal: Carbon rotating against stationary ceramic seat.
- E. Drive: Flexible coupling.
- F. Performance: Refer to Plumbing Equipment Schedule on project Drawings.

2.21 DIELECTRIC CONNECTION

- A. Provide Dielectric isolation between dissimilar metal piping. NOTE: Brass/bronze valves shall not be acceptable for dielectric isolation under this specification.
- B. Two-inch connections may be either dielectric union or isolating flange as required.
- C. Two and one-half inch and larger connections shall incorporate isolating flange kits. Flanges copper pipe shall consist of Class 150 cast copper alloy companion flange with flat face
- D. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- E. Dielectric waterway fittings shall have a copper-silicon casting or a zinc electroplated steel pipe body with high temperature stabilized polyolefin polymer liner; manufactured by Victaulic, Style 647 or PPP, Inc. Series 19000, or Owner approved equal by Anvil.
- F. Dielectric unions shall be rated at 250 psi, ground-joint type with inert, non-corrosive thermoplastic sleeve. End connection materials shall be compatible with respective piping materials; manufactured by EPCO Sales, Inc or Watts. Provide models to suit applicable transitions.
- G. Dielectric flanges shall be rated at 175 psi, have nylon bolt isolators and dielectric gasket. Materials shall be compatible with respective piping materials; manufactured by EPCO Sales, Inc or Watts. Provide models to suit applicable transitions.
- H. Flange insulation kit contain one "E: full face Trojan style insulation gasket manufactured from Nema grade G-10 glass reinforced epoxy retainer with a Nitrile seal, two insulation washers manufactured from Neman grade G-10, two steel (SEA zinc plated steel) back-up washers and one Nema Grade G-10 sleeve for each bolt.

I. Dielectric Nipples:

1. Manufacturer's: Subject to compliance with requirements.
2. Grinnell Mechanical Products.
3. Precision Plumbing Products, Inc.
4. Victaulic Company.

a. Description:

- 1) Standard: IAPMO PS 66
- 2) Electroplated steel nipple, complying with ASTM F1545
- 3) : 300 psig at 250 deg.F
- 4) End connection: Male Thread or grooved.
- 5) Lining: Inert and non-corrosive, propylene.

2.22 TRAP PRIMER ASSEMBLIES

A. Trap Priming devices that rely upon line pressure differential for activation are not allowed.

B. Electronic Trap Primers

1. Electronic trap primers shall provide 10 second water injection to traps every twenty-four hours, complete with galvanized steel box and cover, copper inlet connection, brass ball type stop valve, slow closing 24 VAC solenoid valve with integral strainer, 120-24 VAC transformer, brass atmospheric vacuum breaker, and copper waterway. Refer to schedules on drawings for specifics for each device.

C. Sink or Lavatory Tailpiece Type Trap Primers

1. Provide polished chrome plated cast bronze p-trap with ground joint outlet, threaded wall tube, slip joint nuts, washers and escutcheons, 1/2" polished chrome plated bronze primer tube with compression fitting connection at wall. Assembly shall be Jay R. Smith Model 2698, Precision Plumbing Products LTP-1500 or approved equal of a referenced acceptable manufacture. This type of device shall not serve more than one trap.

D. Vacuum Breaker Trap Primer for use with exposed Flushometers:

1. Priming assembly shall consist of one piece, chrome plated flush connection, water deflector to control the amount of water diverted from the flush 3/8" elbow and flex-bend tube connection from vacuum breaker to wall, diverter wall flange and fittings, chrome plated wall flange and fitting to connect 1/2" NPT pipe, high back pressure vacuum breaker; one-piece bottom hex coupling nut. Basis of design: Sloan Model VBF-72-A1. This type of device shall not serve more than one trap.

2.23 THERMOWELLS

- A. Provide thermowells where indicated on the drawings and where temperature measurement is needed for service or troubleshooting. Locations for thermowells shall include, but not be limited to: hot water return. Thermowells shall be matched with thermometers to be used as far as bore and depth. Thermowells shall be sized so that they will penetrate not less than 25 percent nor more than 50 percent of the pipe diameter in which it is installed.
- B. Where possible, install thermowells in tee fittings where changes in flow directions occur.
- C. Contractor may substitute extended length stainless steel pressure/temperature test ports with integral checks ("Pete's Plugs") for thermowells or where required due to small pipe size (2" or below). Provide with dual seal core inserts of Nordel, rated 0F to 350F. Test port base/pipe connection size shall be 1/2", except that 1/4" may be substituted for pipe sizes 1" and below.
- D. In all cases, ensure installation allows for easy insertion and removal of temperature and pressure probes/instrumentation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.03 INSTALLATION – THERMOMETERS AND GAUGES

- A. Install one pressure gauge for each pump, locate taps before strainers and on suction and discharge of pump; pipe to gauge.
- B. Install gauge taps in piping
- C. Install pressure gauges with pulsation dampers. Provide needle valve or ball valve to isolate each gauge.
- D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inches for installation of thermometer sockets. Allow clearance from insulation.
- E. Provide instruments with scale ranges selected according to service with largest appropriate scale.
- F. Install gauges and thermometers in locations where they are easily read from normal operating level. Install vertical to 45 degrees off vertical.

- G. Adjust gauges and thermometers to final angle, clean windows and lenses, and calibrate to zero.

3.04 INSTALLATION – HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with Section 22 05 29. Provide non-metallic coatings or inserts on attachments for electrolytic protection where attachments are in direct contact with copper piping.

3.05 INSTALLATION – BURIED PIPING SYSTEMS

- A. Verify connection to utility piping system size, location and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than 24 inches of cover (36 inches below paved areas).
- C. Establish minimum separation from sanitary sewer piping in accordance with applicable plumbing code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Excavate pipe trench in accordance with Section 22 00 01.
- F. Install pipe to elevation as indicated on Drawings.
- G. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth; compact to 95 percent maximum density.
- H. Install pipe on prepared bedding.
- I. Route pipe in straight line.
- J. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- K. Install shutoff and drain valves at locations indicated on Drawings.
- L. Install plastic ribbon tape continuous buried 9 inches above pipe line.
- M. Install trace wire continuous over top of plastic pipe buried 9 inches above pipe line.
- N. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 22 00 01.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.

4. Do not use wheeled or tracked vehicles for tamping.

3.06 INSTALLATION – ABOVE GROUND PIPING

- A. Install non-conducting dielectric connections wherever jointing dissimilar metals.
- B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- C. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- D. Group piping whenever practical at common elevations.
- E. Slope piping and arrange systems to drain at low points.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.
- H. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 08 31 13.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- J. Provide support for utility meters in accordance with requirements of utility companies.
- K. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- L. Install domestic water piping in accordance with ASME B31.9.
- M. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
- N. Install unions downstream of valves and at equipment or apparatus connections.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- Q. Install gate, ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- R. Install ball valves for throttling, bypass, or manual flow control services.
- S. Provide lug end butterfly valves adjacent to equipment when functioning to isolate equipment.

- T. Provide spring loaded check valves on discharge of water pumps.
- U. Provide flow controls in water circulating systems.
- V. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- W. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- X. Install water hammer arrestors complete with accessible isolation valve on hot and cold-water supply piping to each fixture or group of fixtures.
- Y. Utilize slow closing valves only. Do not install or allow quick closing valves.

3.07 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.9 and AWS B2.1.
- B. Threaded: Treads shall conform to ASME B1.20. Joint compound shall be applied to male threads only and joints shall be made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound for corrosion protection.
- C. Soldered: Solder joints shall be made in accordance with ASTM B828. The temperature of the joint during soldering shall not be raised above the maximum temperature limitation of the flux.
- D. Press Fittings:
 - 1. The installer of copper press type fittings shall be a factory qualified installer, licensed within the jurisdiction and familiar with the installation of the specific copper press joint system being utilized.
 - 2. Copper press fittings shall be installed using the proper tool, actuator, jaws and ring as instructed by the press fitting manufacturer.
 - 3. Copper and copper alloy press connections shall be made in accordance with the manufacturer's installation instructions.
 - 4. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark to assure the tubing is fully engaged in the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer.

3.08 INSTALLATION – PUMPS

- A. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings.
- C. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve, balancing valve, and shut-off valve on pump discharge.
- D. Provide air cock and drain connection on horizontal pump casings.
- E. Provide drains for bases and seals.
- F. Check, align and certify alignment of base mounted pumps prior to start-up.
- G. Lubricate pumps before start-up.
- H. Contractor shall install pumps and packaged pumping systems in accordance with the manufacturer's instructions. All base mounted pumps to be aligned upon receipt at jobsite, during installation, and after system fill. Contractor shall level and grout each pump according to the manufacturer recommendations to insure proper alignment prior to operation.
- I. Pipe connections to pumps shall be made in such a manner so as not to exert any stress on pump housings. If necessary to meet this requirement, provide additional pipe supports and flex connectors.
- J. Pumps shall NOT be run dry to check rotation.
- K. Provide resilient rubber isolators for piping hangers and stanchions for the first two support locations in suction and discharge piping.
- L. Ensure pumps operate at specified or intended system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

3.09 INSTALLATION – SERVICE CONNECTIONS

- A. Provide 18-gauge galvanized sheet metal sleeve around service main to 6 inch above floor and 6 feet minimum below grade. Size for minimum of 2 inches of loose batt insulation stuffing.

3.10 BACKFLOW PREVENTORS

- A. Backflow prevention devices and assemblies shall be installed in compliance with American Water Works Association Manual M-14 "Backflow Prevention," and the following:
 - 1. Devices and assemblies shall be located as shown on plans.
 - 2. The highest part of any device or assembly shall not be installed over 5 feet above the finish floor. There shall be a minimum of 12 inches clearance above the device/assembly.
 - 3. The lowest part of any double check backflow preventer assembly shall be

installed a minimum of 12 inches above finish floor.

4. The service side of any device/assembly shall have a minimum clearance of 24 inches from the outermost dimension.
5. The non-service side of a double check backflow assembly shall have a minimum clearance of 4 inches from the outermost dimension.
6. All backflow and/or back siphonage assemblies/devices shall be tested in accordance with the rules and regulations of Texas Commission on Environmental Quality and the utility supplying the domestic water before substantial completion inspection is requested.
7. Final reports shall be submitted to local code/inspection authorities and to A/E and utility prior to scheduling Substantial Completion reviews by the A/E.
8. Persons performing the test on backflow and/or back siphonage assemblies/devices shall meet the following requirements:
 - a. Licensed by the Texas Commission on Environmental Quality as a Backflow Prevention Assembly Technician, and
 - b. If required by the utility supplying the water, registered with the utility for testing backflow preventer assemblies.
 - c. Testing of backflow preventer assemblies serving fire protection systems shall be performed by a person or organization with a current certificate of registration from the State Fire Marshal as an independent fire protection sprinkler contractor (Registered Firm) under the direct supervision of a licensed Responsible Managing Employee (RME) as defined by Texas Insurance Code (TIC), Chapter 6003 (formerly Article 5.43-3), Fire Protection Sprinkler System Service and Installation and the Texas Administrative Code Title 28, Chapter 34, Subchapter G – Fire Sprinkler Rules.

3.11 WATER-HAMMER ARRESTORS

- A. Provide water hammer arrestors as shown on the plans and as necessary to prevent water hammer from occurring. As a minimum, provide as follows.
 1. A minimum of one arrestor shall be installed for each fixture header serving up to three fixtures. A minimum of two arrestors shall be installed for each fixture header serving four to seven fixtures. A minimum of three shall be installed for each fixture header serving eight or more fixtures.
 2. Note: "Header" refers to horizontal pipe from which adjacent fixtures are directly connected without intervening horizontal or vertical runs or offsets.
 3. Provide permanently sealed air chamber type water-hammer arrestor at all water closet locations.
 4. Provide an arrestor for each single fixture with a quick closing valve (e.g. single lever handles; wrist blades, push/pull faucets, self-closing faucets, flush valves, solenoid valves, etc.).

5. NOTE: Washing machines and other solenoid operated equipment shall have arrestor (not air chamber) provided for each piece of equipment/fixture.
6. Air chambers are not acceptable under any circumstance.
7. Where indicated, provide water hammer arrestors integral to the fixture (lavatory, sink etc.) supplies equal to Precision Plumbing Products "Mini-Angle Stop". Provide all washing machine and icemaker connections with water hammer arrestors integral to the connection box.

3.12 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements and 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.

3.13 CLEANING AND DISINFECTION

- A. Domestic Water Piping: Domestic cold water and hot water piping shall be thoroughly flushed, cleaned and disinfected in accordance with the appropriate procedure described in the latest edition of ANSI/AWWA C651 or as described in this section. Cold and hot domestic water piping shall be thoroughly flushed with potable water to remove all foreign particles. The piping shall then be sterilized by filling the systems with a solution of chlorine containing 50 PPM of chlorine this solution shall stay in the piping for a minimum period of 24 hours; or the piping shall be filled with a solution of chlorine containing 200PPM of chlorine and this solution shall stay in the piping for a minimum of 3 hours. During which time all valves shall be opened and closed several times in order that all parts of the valve shall be in contact with the solution. After the sterilization period, the system shall be drained and flushed with clean potable water until the residual chlorine content is not greater than 0.2 PPM.
- B. Bacteriological test shall be performed by a third-party testing lab hired by the contractor. SUBMIT testing lab qualification for review and approval by the Owner and A/E. The testing lab shall not have less than five (5) years experience with water testing.
- C. The above procedure shall be performed prior to final connections to utility or existing piping systems in the building to assure no chlorine or other contamination migrates into systems.
- D. Within one-week (7 days) days after cleaning is completed, submit written report signed by supervising craftsman and contractor principal certifying cleaning and sterilization was conducted as specified.
- E. Take samples no sooner than 24 hours after flushing, from at minimum of 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.
- F. The cleaning and disinfection of water lines shall not be done sooner than 3 weeks prior to owner occupancy. If it has been more than 3 weeks then the contractor shall, at his own expense, clean and disinfect the pipe again not sooner than 3 weeks before owner occupancy.

3.14 TESTING

- A. Each system installed under this contract shall be cleaned and tested to appropriate plumbing code for each particular application.
- B. Testing shall also include any additional requirements from the authority having jurisdiction.
- C. Equipment, material, power, and labor necessary for the cleaning, flushing, sterilization, inspection and testing of systems covered within this Specification Section shall be furnished by the Plumbing Contractor. All testing and inspection procedures shall be in accordance with Division 01 and Special Condition requirements of this Contract.
- D. For any requested inspection, the Contractor shall complete prior inspections and tests to ensure that items are ready for inspection and acceptance by the Owner and/or Architect/Engineer. The Contractor shall be responsible for any and all costs incurred by Owner and/or Owner representatives, including consultants, resulting from a review or inspection that was scheduled prematurely.
- E. The Contractor shall conduct the tests and the Owner's Construction Inspector will witness and approve the results.
- F. Verify systems are complete, flushed and clean prior to testing. Isolate all equipment subject to damage from test pressure. Test and inspect for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. Piping being tested shall not leak nor show any loss in test pressure for duration specified.
- G. Leave piping uninsulated, uncovered and unconcealed until it has been tested and approved. Where any portion of piping system must be concealed before completion of entire system, the portion shall be tested separately as specified for the entire system prior to concealment. Contractor shall expose all untested covered or concealed piping.
- H. In cases of minor installation and repairs where specified water and/or air test procedures are deemed impractical, Contractor shall obtain written approval from Owner's Representative to perform alternate testing and inspection procedures. Alternate testing and inspection procedures for minor installation and repairs shall include visual evaluation of installed components by Owner's Representative during a simulation of use.
- I. The water utilized for tests shall be obtained from a potable source of supply.
- J. Prepare testing reports. If testing is performed in segments, submit separate report for each segment, complete with diagram or clear description of applicable portion of piping. After inspection has been approved or portions thereof, certify in writing the time, date, name and title of the persons reviewing the test. This shall also include the description of what portion of the system has been approved. Obtain approval signature by Owner's Representative. A complete record shall be maintained of all testing that has been approved, and shall be made available at the job Site. Upon completion of the work, all records and certifications approving testing requirements shall be submitted to the Owner's Representative before final payment is made.
- K. Gauges used for testing shall have increments as follows:
 - 1. Tests requiring a pressure of 10 psi or less shall utilize a testing gauge having increments of 0.10 psi or less.

2. Tests requiring a pressure of greater than 10 psi but less than or equal to 100 psi shall utilize a testing gauge having increments of 1 psi or less.
 3. Tests requiring a pressure of greater than 100 psi shall utilize a testing gauge having increments of 2 psi or less.
- L. Separately test above and below ground piping.
- M. Do not introduce test water into piping systems when exposure to freezing temperatures is possible.
- N. Do not introduce test water into sections of piping located above existing sensitive areas and/or equipment that may be damaged or contaminated by water leakage. Coordinate with Owner's Representative to determine areas and/or equipment considered as being sensitive.
- O. Defective work or material shall be reworked and replaced, and inspection and test repeated. Repairs shall be made with new materials. Pipe dope, caulking, tape, dresser couplings, etc., shall not be used to correct deficiencies.
- P. The Contractor shall be responsible for cleaning up any leakage during flushing, testing, repairing and disinfecting to the original condition any building parts subjected to spills or leakage.
- Q. All backflow and/or back siphonage assemblies/devices shall be tested in accordance with the rules and regulations of Texas Commission on Environmental Quality and the utility supplying the domestic water before substantial completion inspection is requested.
1. Final reports shall be submitted to local code/inspection authorities and to A/E and utility prior to scheduling Substantial Completion reviews by the A/E.
 2. Persons performing the test on backflow and/or back siphonage assemblies/devices shall meet the following requirements:
 - a. Licensed by the Texas Commission on Environmental Quality as a Backflow Prevention Assembly Technician, and
 - b. If required by the utility supplying the water, registered with the utility for testing backflow preventer assemblies.
- R. Domestic hot water system:
1. Test Remote fixtures to determine hot water is available within 30 seconds. Provide a report and a drawing indicated fixtures tested and the duration of time to provide 110 °F.
 2. Record temperature at each return pump.
- S. Pressure test all water piping in accordance with the applicable plumbing code and local AHJ.
- T. All testing of pumps shall be by owner representative and a report shall be provided.

- U. Equipment, material, power, and labor necessary for the cleaning, flushing, sterilization, inspection and testing of systems covered within this Specification Section shall be furnished by the Plumbing Contractor. All testing and inspection procedures shall be in accordance with Division 01 and Special Condition requirements of this Contract.
- V. For any requested inspection, the Contractor shall complete prior inspections and tests to ensure that items are ready for inspection and acceptance by the Owner and/or Architect/Engineer. The Contractor shall be responsible for any and all costs incurred by Owner and/or Owner representatives, including consultants, resulting from a review or inspection that was scheduled prematurely.

END OF SECTION

SECTION 22 13 00 – FACILITY SANITARY SEWERAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Sanitary sewer and vent piping – below grade.
2. Sanitary sewer and vent piping – above grade.
3. Floor drains, Area Drains and Floor sinks.
4. Cleanouts.

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete: Execution requirements for placement of concrete specified by this section.
2. Section 07 84 00 – Firestopping: Product requirements for firestopping for placement by this section.
3. Section 08 32 13 – Access Doors and Frames: Product requirements for access doors for placement by this section.
4. Section 09 90 00 – Painting and Coating: Product and execution requirements for painting specified by this section.
5. Section 22 00 01 – Basic Plumbing Requirements.
6. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
7. Section 22 05 53 – Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
8. Section 22 07 00 – Plumbing Insulation: Product and execution requirements for pipe insulation.
9. Section 26 05 03 – Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.
10. Division 31 sections for excavation, trench and backfill required by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A112.14.1 – Backwater Valves.

2. ASME A112.21.1 – Floor Drains.
3. ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
4. ASME B16.3 – Malleable Iron Threaded Fittings.
5. ASME B16.4 – Gray Iron Threaded Fittings.
6. ASME B31.9 – Building Services Piping.

B. ASTM International:

1. ASTM A47/A47M – Standard Specification for Ferritic Malleable Iron Castings.
2. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A74 – Standard Specification for Cast Iron Soil Pipe and Fittings.
4. ASTM A234/A234M – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
5. ASTM A395/A395M – Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
6. ASTM A536 – Standard Specification for Ductile Iron Castings.
7. ASTM A746 – Standard Specification for Ductile Iron Gravity Sewer Pipe.
8. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections.
9. ASTM C478M – Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
10. ASTM C564 – Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
11. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
12. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
13. ASTM D2241 – Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
14. ASTM D2464 – Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
15. ASTM D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

16. ASTM D2467 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 17. ASTM D2564 – Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 18. ASTM D2855 – Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 19. ASTM D3311 – Standard Specification for Drain, Waste and Vent (DWV) Plastic Fitting Patterns.
- C. Cast Iron Soil Pipe Institute:
1. CISPI 301 – Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
 2. CISPI 310 – Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 – Pipe Hangers and Supports: Materials, Design and Manufacturer.
 2. MSS SP 69 – Pipe Hangers and Supports: Selection and Application.
 3. MSS SP 89 – Pipe Hangers and Supports: Fabrication and Installation Practices.
- E. Plumbing and Drainage Institute:
1. Standard PDI G101 – Testing and Rating Procedure for Grease Interceptors.

1.03 SUBMITTALS

- A. Refer to Section 01 33 00 for Submittal procedures.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sewage-ejectors, and manholes.
- C. Product Data:
1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 4. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.

- 5. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
 - D. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
 - E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- 1.04 CLOSEOUT SUBMITTALS
- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
 - B. Project Record Documents: Record actual locations of equipment and clean-outs.
 - C. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include, spare parts lists, exploded assembly views for pumps and equipment.
- 1.05 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
 - B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.
- 1.06 DELIVERY, STORAGE AND HANDLING
- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
 - B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- 1.07 ENVIRONMENTAL REQUIREMENTS
- A. Section 01 60 00 – Product Requirements.
 - B. Do not install underground piping when bedding is wet or frozen.
- 1.08 FIELD MEASUREMENTS
- A. Verify field measurements prior to fabrication.
- 1.09 WARRANTY
- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.
 - B. Furnish one-year manufacturer warranty for material.
- 1.10 EXTRA MATERIALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of pump seals.

PART 2 PRODUCTS

2.01 SANITARY SEWER AND VENT PIPING – BELOW GRADE

- A. All cast iron soil, waste and vent pipe and fittings shall conform to the requirements of CISPI Standard 301, ASTM A888 or ASTM A74. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International. Acceptable manufacturers of cast iron soil pipe and fittings are AB&I, Charlotte Pipe and Tyler Pipe.
- B. Cast Iron Soil Pipe: ASTM A74, service weight, bell and spigot ends.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: Hub-and-spigot with compression gaskets conforming to the requirements of ASTM C-564 and ASTM C-1563.
- C. Cast Iron Pipe: CISPI 301, hub-less, service weight.
 - 1. Fittings: Cast iron, CISPI 301.
 - 2. Joints: Hubless pipe and fittings shall be joined by No-Hub couplings conforming to CISPI Standard 310 and listed by NSF International.
 - 3. Below grade piping shall be joined by super duty shielded stainless steel couplings with rubber sleeves and stainless-steel bands and tightening devices, conforming to ASTM C564; equivalent to Husky SD 4000.
- D. PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material, bell and spigot style solvent sealed joints.
 - 1. Fittings: PVC, ASTM D2665, Schedule 40.
 - 2. Joints: ASTM F656, Lo-VOC (SCAQMD 116/316A) Purple Primer; ASTM D2855; solvent weld with ASTM D2564 solvent cement.

2.02 SANITARY SEWER AND VENT PIPING – ABOVE GRADE

- A. All cast iron soil, waste and vent pipe and fittings shall conform to the requirements of CISPI Standard 301, ASTM A888 or ASTM A74. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International. Acceptable manufacturers of cast iron soil pipe and fittings are AB&I, Charlotte Pipe and Tyler Pipe.
- B. Cast Iron Pipe: ASTM A74, service weight.
 - 1. Fittings: Cast iron, ASTM A74.

2. Joints: Hub-and-spigot with compression gaskets conforming to the requirements of ASTM C-564 and ASTM C-1563.
- C. Cast Iron Pipe: CISPI 301, hub-less, service weight.
1. Fittings: Cast iron, CISPI 301.
 2. Joints: Hubless pipe and fittings shall be joined by No-Hub couplings conforming to CISPI Standard 310 and listed by NSF International.
 - a. Above grade waste piping shall be joined by heavy-duty shielded stainless-steel couplings with rubber sleeves and stainless-steel bands and tightening devices, conforming to ASTM C564; equivalent to Tyler Wide Body, Mission Rubber Co. Heavyweight, Fernco Heavy Duty or Husky HD 2000.
 - b. Above grade vent piping shall be joined by standard duty shielded stainless steel couplings with rubber sleeves and stainless-steel bands and tightening devices, conforming to ASTM C564; as manufactured by Tyler Pipe, Mission Rubber Co. or ANACO.
- D. PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material, bell and spigot style solvent sealed joints.
1. Fittings: PVC, ASTM D2665, Schedule 40.
 2. Joints: ASTM D2855; solvent weld with ASTM D2564 solvent cement.

2.03 FLOOR DRAINS, AREA DRAINS AND FLOOR SINKS

- A. Refer to Plumbing Equipment Schedule on Drawings.

2.04 CLEANOUTS

- A. Refer to Plumbing Equipment Schedule on Drawings.
- B. Exterior Surfaced Areas: Round cast nickel bronze access frame and non-skid cover.
- C. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket.
- D. Interior Finished Floor Areas: Galvanized cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas.
- E. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless-steel access cover secured with machine screw.
- F. Interior Unfinished Accessible Areas: Calked or threaded type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 INSTALLATION – HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with Section 22 05 29:

3.04 INSTALLATION – BURIED PIPING SYSTEMS

- A. Verify connection to site utility piping system; size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than 1.5 ft of cover.
- C. Establish minimum separation of other services piping in accordance with Plumbing Code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Excavate pipe trench in accordance with Section 22 00 01 and Division 31 specifications.
- F. Install pipe to elevation as indicated on Drawings.
- G. Place bedding material at trench bottom to provide uniform bedding for piping.
- H. Place bedding materials in one continuous layer not exceeding six inches compacted depth; compact to 95 percent maximum density.
- I. Install pipe on prepared bedding.
- J. Route pipe in straight line.
- K. Install plastic ribbon tape continuous over top of pipe, 9 inches above pipe line.
- L. Install trace wire continuous over top of plastic pipe buried 9 inches above pipe line.
- M. Pipe Cover and Backfilling:
 - 1. Install underground Thermoplastic piping soil and waste drainage piping according to ASTM D 2321.

2. Backfill trench in accordance with Section 22 00 01 and Division 31 specifications.
3. Maintain optimum moisture content of fill material to attain required compaction density.
4. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
5. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
6. Do not use wheeled or tracked vehicles for tamping.

3.05 INSTALLATION – ABOVE-GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- G. Install piping to maintain headroom. Do not spread piping, conserve space.
- H. Group piping whenever practical at common elevations.
- I. Support cast iron drainage piping at every joint.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.
- L. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 08 31 13.
- M. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean and apply one coat of zinc rich primer to welding.

- O. Prepare exposed, unfinished pipe, fittings, supports and accessories ready for finish painting. Refer to Section 09 90 00.
- P. Install bell and spigot pipe with bell end upstream.
- Q. Sleeve pipes passing through partitions, walls and floors. Refer to Section 07 84 00.
- R. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 07 84 00.

3.06 DRAINS, CLEANOUTS AND SIMILAR COMPONENTS

- A. Extreme care shall be used to set the top elevation of floor drains and floor sinks to meet the low point elevation of the finished floor. Final mounting elevation of floor drain strainers, floor sink grates, cleanouts tops, etc. shall be flush with finished floor.
- B. Coordinate with General Contractor to ensure floor is sloped to floor drain and/or floor sink locations for a minimum of 2-foot radius from the floor drain.
- C. Provide floor drains and/or floor sinks complete with trap primer connections, piping, and trap primer assemblies.
- D. Exterior cleanouts, single or double, shall be set in reinforced concrete (minimum 18 inches by 18 inches by 6 inches thick or as indicated on Drawings) at finished grade level. Provide countersunk brass cleanout plugs in cast iron ferrules. PVC plugs shall not be acceptable. Exception: Where cleanouts are located in architectural flatwork (sidewalks, patios, etc.), cleanouts shall be floor cleanout style as indicated on drawing schedules.
- E. Floor drains and/or floor sinks in mechanical rooms:
 - 1. Ensure that all floor drains and/or floor sinks in mechanical rooms are provided with maximum size (e.g., diameter) strainers. In addition, where multiple drains pipe to a floor drain provide a 3-1/2 inch by 8-1/4 inch by 3-1/2 inch high elongated funnel.
 - 2. In addition, where multiple drains pipe to a floor drain, provide a 12-inch diameter by 3 inches (approximately) high schedule 40 black steel pipe segment to serve as a splash guard. Mount splash guard with approximately 1/16-inch gap between bottom of guard and floor to allow drainage to floor drain beneath splash guard.
 - 3. Coordinate funnel/splash guard installation with Mechanical Contractor for proper condensate drain piping heights.
- F. Drains located in shower areas, restrooms, Kitchens and other wet areas with water proofing membrane.
 - 1. During slab pour provide an oversized concrete blocking for drain locations. The intent is to be provide the ability to properly level the drain and obtain the correct height of drain for floor finishes, as needed, after the slab
 - 2. Confirm water proof membrane type and floor drain are compatible.

3. Properly protect drain openings to prevent and liquid water proofing membrane or epoxy from entering the drainage system.

G. Drain Locations in Stained concrete.

1. Coordinate drain height and drain location with slab height. Install drain in accordance with the direction of the stained concrete provider.

3.07 PLASTIC PIPE AND JOINT FABRICATION

- A. Cut plastic pipe with pipe cutters using a cutting wheel specifically designed for plastic pipe.
- B. Remove all burrs, chips, filings, etc. from both the I.D. and O.D. of the pipe before joining. Use a knife, deburring tool, or a half-pound coarse file to remove all burrs.
- C. Bevel all pipe ends to minimize the chances of wiping the solvent cement from the I.D. of the fitting as the pipe is socketed. Use a beveling tool designed to bevel pipe at a 10° to 15° angle and a depth of 1/16" to 3/32".
- D. Using a clean, dry, cotton rag, wipe away all loose dirt and moisture from the I.D. and O.D. of the pipe end and the I.D. of the fitting. Do not solvent weld wet surfaces.
- E. Apply primer to the pipe surface in the same manner, making sure that the length of pipe evenly brushed is at least equal to the fitting socket depth.
- F. For checking penetration, scratch or scrape away the primed surface until a few thousandths of an inch can be so removed. Repeat applications of primer to either or both surfaces as necessary. In cold weather, allow more time for proper penetration.
- G. Cover the outer pipe surface literally with solvent cement for a length at least equal to that of the fitting socket depth.
- H. Continue alternate application to the fitting socket with a medium layer of solvent cement. Avoid puddling in the socket. On belled end pipe, do not coat beyond the socket depth or allow cement to run beyond the bell.
- I. Apply a second coat of cement to the pipe. Cement layers must be without voids and sufficient to fill any gaps in the joints.
- J. Immediately upon finishing cement application and before it starts to set, insert the pipe to the full socket depth while rotating the pipe or fitting 1/4 turn to ensure complete and even distribution of the cement. Hold joint together for a minimum of 10 to 15 seconds to make sure that pipe does not move back out of the socket.
- K. Immediately after joining and before joint is set, gently place joint onto a level surface, and wipe off all excess cement from the circumference of the joint.
- L. Do not perform joining operations if ambient temperature is below 40 F. Allow a minimum of 72 hours of joint drying time before subjecting joints to any appreciable internal pressure.

3.08 DRAIN PIPE AND FITTINGS

- A. Offsets and Fittings.

1. Use reduction fittings to connect two pipes of different diameter.
 2. Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and sixth-, eighth-, and sixteenth-bends. Sanitary tees may be used on vertical stacks. Use long sweeps at the base of risers.
 3. Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a Deep Seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.
 4. For sets of fixtures installed in 4-inch walls, provide a separate waste and vent line for each fixture (do not interconnect in wall). Connect the waste lines underfloor and the vent lines above the ceiling. Maintain structural and aesthetic integrity of walls.
 5. Do not route any piping above electrical control panels and related electrical equipment. Prior to installation of any piping, determine the actual space requirements and the location of all electrical panels and related electrical equipment. Make all offsets and adjustments as required.
 6. Discharge from the oil separator to a floor drain with a funnel to maintain an indirect connection to the sanitary sewer.
- B. Floor Drains. Provide all required floor drains complete with drain lines and vent lines as required by the section on Drains, Hydrants and Cleanouts.
- C. Cleanouts.
1. Provide drainage lines with properly specified cleanouts. Provide all as required by the section on drains, hydrants and cleanouts.

3.09 VENT PIPING

- A. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 6-inches above the roof.
- B. Coordinate location of vent penetrations with roofing trades; flashing to be done by roofer.
- C. Offset all vents located near building edge such that no vent through roof piping is located within 5-feet from the building edge (measured from building line not building eave). Make offsets in roof structure space.
- D. Terminate vent through roof not less than 15-feet away from any shaft, window or outside air intake openings.
- E. All vent and vent branch pipes shall be graded and connected to drip back to sanitary waste piping by gravity.

3.10 ROUGH-IN AND FINAL CONNECTIONS

- A. Make rough-in and final connection of all services to all fixtures requiring plumbing connections. Contractor shall be responsible for installing fixtures at locations shown on the Architectural drawings and providing all service connections at required locations.

- B. Rough-in and final connection of services to all equipment shall be installed in accordance with the latest edition of the manufacturer's rough-in measurements manual. Contractor shall obtain all such documents.
- C. Use threaded sanitary tapped tee pipe fittings for p-trap connections at walls.
- D. Provide service connections to all plumbing fixtures specified and to all equipment furnished by others.
- E. Install all piping and associated equipment in accordance to manufacturer's recommendations using recommended tools.
- F. Provide all fittings and appurtenances required for a complete and working system.

3.11 COORDINATION

- A. Making adjustments to field conditions is considered a part of the work required. Do not use contract drawings accompanying these specifications for rough-in locations but only for pipe sizing and general routing.
- B. Contractor shall examine and familiarize himself with the Architectural, Structural, Electrical and Mechanical Drawings to be knowledgeable of all plumbing connections required and space limitations.
- C. The Drawings are diagrammatic and are not intended to show all the fittings required. Contractor shall include in his bid, costs for items of material and labor which are not specifically called for in drawings or specifications, but which are required to make plumbing installation. Contractor shall make any necessary changes to avoid beams, footings, columns, piers, vents, ducts, equipment or other obstructions.
- D. In any case where a pipe shown on a plan sheet differs from that shown on a riser, schematic or detail, use the larger of the two sizes shown.

3.12 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements and Section 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Test sanitary waste, grease waste, chemical resistant waste and vent piping system in accordance with applicable code and local authority having jurisdiction.
- C. Testing:
 - 1. After each section of the sanitary waste, acid waste and grease waste systems have been set within project area, all outlets shall be temporarily "plugged up", except as are required for testing as described herein. Each section of piping shall be tested to a level of at least 10 feet above the pipe being tested. The pipes being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for a minimum of 2 hours. If after 2 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 2-hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
 - 2. Should the completion of these tests leave any reasonable question of a doubt

relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

- D. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work of other trades.
- E. Place temporary caps or plugs in ends of uncompleted piping and when work stops at the end of each day.

END OF SECTION

SECTION 22 14 00 – FACILITY STORM DRAINAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Storm water piping buried below grade.
2. Storm water piping above grade.
3. Roof drains, area drains, planter drains and canopy drains.
4. Cleanouts.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of concrete specified by this section.
2. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
3. Section 08 31 13 - Access Doors and Frames: Product requirements for access doors for placement by this section.
4. Section 09 90 00 - Painting and Coating: Execution requirements for painting material specified by this section.
5. Section 22 00 01 – Basic Plumbing Requirements.
6. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
7. Section 22 05 53 - Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
8. Section 22 07 00 - Plumbing Insulation: Product and execution requirements for pipe insulation.
9. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.
10. Division 31 sections for excavation, trench and backfill required by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A112.21.1M - Floor Drains.

2. ASME A112.21.2M - Roof Drains.
 3. ASME B31.9 - Building Services Piping.
- B. ASTM International:
1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 2. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 4. ASTM C443 - Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
 5. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections.
 6. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 7. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 8. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 9. ASTM D2464 - Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 10. ASTM D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 11. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 12. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- C. Cast Iron Soil Pipe Institute:
1. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 2. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 - Pipe Hangers and Supports: Materials, Design and Manufacturer.

2. MSS SP 69 - Pipe Hangers and Supports: Selection and Application.
3. MSS SP 89 - Pipe Hangers and Supports: Fabrication and Installation Practices.

1.03 SUBMITTALS

- A. Refer to Section 01 33 00 for Submittal procedures.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sump-pumps, catch basins and manholes.
- C. Product Data:
 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 2. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
 3. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of equipment and clean-outs.
- C. Operation and Maintenance Data: Submit spare parts lists, exploded assembly views for pumps and equipment.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one-year manufacturer warranty for sump pumps.

1.10 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of pump seals.

PART 2 PRODUCTS

2.01 STORM WATER PIPING, BELOW GRADE

- A. All cast iron soil, waste and vent pipe and fittings shall conform to the requirements of CISPI Standard 301, ASTM A888 or ASTM A74. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International. Acceptable manufacturers of cast iron soil pipe and fittings are AB&I, Charlotte Pipe and Tyler Pipe.
- B. Cast Iron Soil Pipe: ASTM A74, service weight, bell and spigot ends.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: Hub-and-spigot with compression gaskets conforming to the requirements of ASTM C564 and ASTM C1563.
- C. Cast Iron Pipe: CISPI 301, hub-less, service weight.
 - 1. Fittings: Cast iron, CISPI 301.
 - 2. Joints: Hubless pipe and fittings shall be joined by No-Hub couplings conforming to CISPI Standard 310 and listed by NSF International.
 - 3. Below-grade storm drain piping shall be joined by super duty shielded stainless steel couplings with rubber sleeves and stainless-steel bands and tightening devices, conforming to ASTM C564; equivalent to Husky SD 4000.
- D. PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material, bell and spigot

style solvent sealed joints.

1. Fittings: PVC, ASTM D2665, Schedule 40.
2. Joints: ASTM D2855; solvent weld with ASTM D2564 solvent cement.

2.02 STORM WATER PIPING, ABOVE GRADE

- A. All cast iron soil, waste and vent pipe and fittings shall conform to the requirements of CISPI Standard 301, ASTM A888 or ASTM A74. All cast iron pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and shall be listed by NSF International. Acceptable manufacturers of cast iron soil pipe and fittings are AB&I, Charlotte Pipe and Tyler Pipe.
- B. Cast Iron Soil Pipe: ASTM A74, service weight, bell and spigot ends.
 1. Fittings: Cast iron, ASTM A74.
 2. Joints: Hub-and-spigot with compression gaskets conforming to the requirements of ASTM C564 and ASTM C1563.
- C. Cast Iron Pipe: CISPI 301, hub-less, service weight.
 1. Fittings: Cast iron, CISPI 301.
 2. Joints: Hubless pipe and fittings shall be joined by No-Hub couplings conforming to CISPI Standard 310 and listed by NSF International.
 3. Above-grade storm drain piping shall be joined by heavy duty shielded stainless steel couplings with rubber sleeves and stainless-steel bands and tightening devices, conforming to ASTM C564; equivalent to Tyler Wide Body, Mission Rubber Co. Heavyweight, Fernco Heavy Duty or Husky HD 2000.
 4. Provide No-hub fitting thrust restraint at each change of direction. Restraints shall consist of galvanized steel pipe riser clamps on both sides of fitting connected with minimum 1/2" galvanized steel threaded rods and necessary hardware or engineered no-hub fitting restraints equal to Holdrite #117 series.
- D. D1785, Schedule 40, polyvinyl chloride (PVC) material, bell and spigot style solvent sealed joints.
 1. Fittings: PVC, ASTM D2466, Schedule 40.
 2. Joints: ASTM D2855; solvent weld with ASTM D2564 solvent cement.

2.03 ROOF DRAINS, AREA DRAINS, PLANTER DRAINS AND CANOPY DRAINS

- A. Refer to Plumbing Equipment Schedule on Drawings.

2.04 CLEANOUTS

- A. Refer to Plumbing Equipment Schedule on Drawings.

- B. Exterior Surfaced Areas: Round cast nickel bronze access frame and non-skid cover.
- C. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket.
- D. Interior Finished Floor Areas: Galvanized cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas.
- E. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless-steel access cover secured with machine screw.
- F. Interior Unfinished Accessible Areas: Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

2.05 SEDIMENT INTERCEPTORS

- A. Refer to Plumbing Equipment Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 INSTALLATION - HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with Section 22 05 29.

3.04 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection to site utility piping system, size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than one ft of cover.
- C. Establish minimum separation from other services piping in accordance with applicable Plumbing code.

- D. Remove scale and dirt on inside of piping before assembly.
- E. Excavate pipe trench in accordance with Section 22 00 01 and Division 31 specifications.
- F. Install pipe to elevation as indicated on Drawings.
- G. Place bedding material at trench bottom to provide uniform bedding for piping.
- H. Place bedding materials in one continuous layer not exceeding six inches compacted depth; compact to 95 percent maximum density.
- I. Install pipe on prepared bedding.
- J. Route pipe in straight line.
- K. Install plastic ribbon tape continuous over top of pipe 9 inches above pipe line.
- L. Install trace wire continuous over top of plastic pipe buried 9 inches above pipe line.
- M. Pipe Cover and Backfilling:
 - 1. Install underground Thermoplastic piping soil and waste drainage piping according to ASTM D 2321.
 - 2. Backfill trench in accordance with Section 22 00 01 and Division 31 specifications.
 - 3. Maintain optimum moisture content of fill material to attain required compaction density.
 - 4. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 5. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 6. Do not use wheeled or tracked vehicles for tamping.

3.05 INSTALLATION - ABOVE GROUND PIPING

- A. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum. Maintain gradients.
- B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearance at cleanout for snaking drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Install floor cleanouts at elevation to accommodate finished floor.
- E. Install non-conducting dielectric connections wherever jointing dissimilar metals.

- F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- G. Install piping to maintain headroom. Group piping to conserve space.
- H. Group piping whenever practical at common elevations.
- I. Support cast iron drainage piping at every joint.
- J. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- K. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.
- L. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 08 31 13.
- M. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- N. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- O. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- P. Install bell and spigot pipe with bell end upstream.
- Q. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
- R. Insulate all horizontal storm drain piping (both primary and overflow pipe) and all roof drain bodies. Refer to Section 22 07 00.
- S. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 07 84 00.
- T. Provide No-hub fitting thrust restraint at the following locations at each change of direction (horizontal or vertical) and/or each branch connection in above grade storm drain piping (both primary and emergency overflow).

3.06 PLASTIC PIPE AND JOINT FABRICATION

- A. Cut plastic pipe with pipe cutters using a cutting wheel specifically designed for plastic pipe.
- B. Remove all burrs, chips, filings, etc. from both the I.D. and O.D. of the pipe before joining. Use a knife, deburring tool, or a half-pound coarse file to remove all burrs.
- C. Bevel all pipe ends to minimize the chances of wiping the solvent cement from the I.D. of the fitting as the pipe is socketed. Use a beveling tool designed to bevel pipe at a 10° to 15° angle and a depth of 1/16" to 3/32".
- D. Using a clean, dry, cotton rag, wipe away all loose dirt and moisture from the I.D. and O.D. of the pipe end and the I.D. of the fitting. Do not solvent weld wet surfaces.

- E. Apply primer to the pipe surface in the same manner, making sure that the length of pipe evenly brushed is at least equal to the fitting socket depth.
- F. For checking penetration, scratch or scrape away the primed surface until a few thousandths of an inch can be so removed. Repeat applications of primer to either or both surfaces as necessary. In cold weather, allow more time for proper penetration.
- G. Cover the outer pipe surface literally with solvent cement for a length at least equal to that of the fitting socket depth.
- H. Continue alternate application to the fitting socket with a medium layer of solvent cement. Avoid puddling in the socket. On belled end pipe, do not coat beyond the socket depth or allow cement to run beyond the bell.
- I. Apply a second coat of cement to the pipe. Cement layers must be without voids and sufficient to fill any gaps in the joints.
- J. Immediately upon finishing cement application and before it starts to set, insert the pipe to the full socket depth while rotating the pipe or fitting 1/4 turn to ensure complete and even distribution of the cement. Hold joint together for a minimum of 10 to 15 seconds to make sure that pipe does not move back out of the socket.
- K. Immediately after joining and before joint is set, gently place joint onto a level surface, and wipe off all excess cement from the circumference of the joint.
 - a. Do not perform joining operations if ambient temperature is below 40 F. Allow a minimum of 72 hours of joint drying time before subjecting joints to any appreciable internal pressure.

3.07 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements and Section 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Test storm drainage piping system in accordance with applicable code and local authority having jurisdiction.
- C. Testing:
 - 1. After each section of the storm drainage systems have been set within project area, all outlets shall be temporarily "plugged up", except as are required for testing as described herein. Each section of piping shall be tested to a level of at least 10 feet above the pipe being tested. The pipes being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for a minimum of 2 hours. If after 2 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 2-hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
 - 2. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made

inaccessible.

- D. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work of other trades.
- E. Place temporary caps or plugs in ends of uncompleted piping and when work stops at the end of each day.

END OF SECTION

SECTION 22 17 00 – FACILITY NATURAL GAS PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Natural gas piping below grade.
2. Natural gas piping above grade.
3. Unions and flanges.
4. Valves.
5. Pipe hangers and supports.
6. Strainers.
7. Natural gas pressure regulators.
8. Natural gas pressure relief valves.
9. Underground pipe markers.
10. Bedding and cover materials.

B. Related Sections:

1. Section 05 12 00 – Structural Steel Framing: Product requirements for touch-up painting of structural steel.
2. Section 05 21 00 – Steel Joist Framing: Product requirements for touch-up painting of steel joists.
3. Section 07 84 00 – Firestopping: Product requirements for firestopping for placement by this section.
4. Section 08 31 13 – Access Doors and Frames: Access doors for concealed valves and accessories.
5. Section 09 90 00 – Painting and Coating: Product requirements for painting for placement by this section.
6. Section 22 00 01 – Basic Plumbing Requirements.
7. Section 22 05 29 – Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports [and firestopping] for placement by this section.

8. Section 22 05 53 – Identification for Plumbing Piping and Equipment: Product requirements for valve and pipe identification for placement by this section.
9. Section 33 51 00 – Natural-Gas Distribution: Product and execution requirements for site natural gas distribution systems.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.15 – Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

B. American Society of Mechanical Engineers:

1. ASME B16.3 – Malleable Iron Threaded Fittings.
2. ASME B16.26 – Cast Copper Alloy Fittings for Flared Copper Tubes.
3. ASME B16.33 – Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
4. ASME B31.9 – Building Services Piping.
5. ASME Section IX – Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.

C. ASTM International:

1. ASTM A53/A53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M – Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
4. ASTM B88M – Standard Specification for Seamless Copper Water Tube (Metric).
5. ASTM B280 – Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
6. ASTM B749 – Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
7. ASTM F708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Welding Society:

1. AWS D1.1 – Structural Welding Code - Steel.

- E. American Water Works Association:
 - 1. AWWA C105 – American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 – Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 67 – Butterfly Valves.
 - 3. MSS SP 69 – Pipe Hangers and Supports - Selection and Application.
 - 4. MSS SP 78 – Cast Iron Plug Valves, Flanged and Threaded Ends.
 - 5. MSS SP 89 – Pipe Hangers and Supports - Fabrication and Installation Practices.
 - 6. MSS SP 110 – Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- G. National Fire Protection Association:
 - 1. NFPA 54 – National Fuel Gas Code.
- H. Underwriters Laboratories Inc.:
 - 1. UL 842 – Valves for Flammable Fluids.
- I. International Code Council:
 - 1. International Fuel Gas Code.

1.03 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- D. Use plug or ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.

- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
- C. Test Reports: Indicate results of piping system pressure test.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
- E. Provide a table of all regulators which indicate, Mark, size, spring size and/or color, pressure, area of equipment served.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves, piping system, and system components.
- C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.06 QUALITY ASSURANCE

- A. Perform natural gas Work in accordance with NFPA 54 and International Fuel Gas Code.
- B. Perform work in accordance with International Fuel Gas Code and local gas company requirements.
- C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- D. Perform Work in accordance with authority having jurisdiction and AWS D1.1 for welding hanger and support attachments to building structure.
- E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years of documented experience.
- C. Technicians performing fusion process shall be currently certified by the Texas Railroad Commission and shall **submit a resume showing experience on comparable fusion procedures within the last twelve (12) months.**

1.08 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Requirements for coordination.
- B. Coordinate trenching, excavating, bedding and backfilling of buried piping systems with requirements of Section 31 23 33.

1.12 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish 1-year manufacturer warranty for valves excluding packing.

1.13 EXTRA MATERIALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two packing kits for each type and size valve.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING – BELOW GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M forged steel welding type.
 - 2. Joints: ASME B31.9, welded.
 - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.
- B. Polyethylene Pipe: ASTM D2513, PE24061/SDR 11.5
 - 1. Fittings: ASTM D2513; Butt fusion complying with ASTM-D3261 or socket fusion complying with ASTM-D2683.
 - 2. Joints: Fusion welded.
 - 3. Transitions from polyethylene to steel pipe shall be by factory fabricated transition fitting (i.e. Central Double "O" Seal or equal) or transition riser (Central Plastics Part No. 600 Series or equal). Minimum horizontal dimension for transition riser shall be 30 inches. Anodeless service riser may be used when interior carrier pipe complies with the specifications for the location of the pipe.

2.02 NATURAL GAS PIPING – ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
 - 2. Joints: Threaded for pipe 2 inches and smaller; welded for pipe 2-1/2 inches and larger.

2.03 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Copper Piping: Class 150, bronze unions with [soldered] [brazed joints].
 - 3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Copper Piping: Class 150, slip-on bronze flanges.
 - 3. Gaskets: 1/16 inches thick preformed neoprene gaskets.

2.04 BALL VALVES

- A. 1/4 inch to 1 inch: MSS SP 110, Class 125, two-piece, threaded ends, bronze body, chrome-plated bronze ball, reinforced teflon seats, anti-static device, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.
- B. 1-1/4 inch to 3 inch: MSS SP 110, Class 125, two piece, threaded ends, bronze body, chrome-plated bronze ball, reinforced teflon seats, anti-static device, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port.

2.05 PLUG VALVES

- A. 2 inches and Smaller: MSS SP 78, Class 150, semi-steel construction, round port, full pipe area, pressure lubricated, Teflon packing, threaded ends. Furnish one plug valve wrench for every ten plug-valves with minimum of one wrench.
- B. 2-1/2 inches and Larger: MSS SP 78, Class 150, semi-steel construction, round port, full pipe area, pressure lubricated, Teflon packing, flanged ends. Furnish wrench-operated.

2.06 STRAINERS

- A. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- B. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.07 NATURAL GAS PRESSURE REGULATORS

- A. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
 - 1. Temperatures: minus 20 degrees F to 150 degrees F.
 - 2. Body: Cast iron.
 - 3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
 - 4. Disk, diaphragm, and O-ring: Nitrile.
 - 5. Maximum inlet pressure: 150 psig.
 - 6. Furnish sizes 2 inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.

2.08 NATURAL GAS PRESSURE RELIEF VALVES

- A. Product Description: Spring loaded type relief valve.
 - 1. Body: Aluminum.
 - 2. Diaphragm: Nitrile.

3. Orifice: Aluminum.
4. Maximum operating temperature: 150 degrees F.
5. Inlet Connections: Threaded.
6. Outlet or Vent Connection: Same size as inlet connection.

2.09 UNDERGROUND PIPE MARKERS

- A. Plastic Ribbon Tape: Yellow colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- B. Trace Wire: Magnetic detectable conductor, yellow colored plastic covering, imprinted with "Natural Gas Service" in large letters.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION – INSERTS

- A. Provide inserts for placement in concrete forms.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.04 INSTALLATION – PIPE HANGERS AND SUPPORTS

- A. Install pipe hangers and supports in accordance with Section 23 05 29.

3.05 INSTALLATION – BURIED PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54 and International Fuel Gas Code.
- B. Verify connection to existing piping system size, location and invert are as indicated on Drawings.
- C. Establish elevations of buried piping with not less than 18 inches of cover, unless noted otherwise on plans.
- D. Establish minimum separation from other services piping in accordance with International Fuel Gas Code and NFPA 54.
- E. Remove scale and dirt on inside of piping before assembly.
- F. Excavate pipe trench in accordance with Section 22 00 01.
- G. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 4 inches compacted depth; compact to 95 percent maximum density.
- H. Install pipe on prepared bedding.
- I. Route pipe in straight line.
- J. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- K. Metal Pipe: Install plastic ribbon tape continuous over top of metal pipe buried 6 inches below finish grade, above pipe line.
- L. Plastic Pipe: Install plastic ribbon tape continuous over top of plastic pipe buried 6 inches below finish grade, above pipe line. Tracer wire shall be spirally wrapped around the pipe (minimum of one revolution for every three feet of pipe).
- M. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 22 00 01.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.
- N. Connections made between plastic piping and metallic piping shall be made only with transition fittings categorized as Category I in accordance with ASTM D2513.
- O. All branch connections shall be made using tees.

3.06 INSTALLATION – ABOVE-GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54 and International Fuel Gas Code.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Sleeve pipe passing through partitions, walls and floors. Refer to Section 22 05 29.
- H. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 07 84 00.
- I. Provide clearance for access to valves and fittings.
- J. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer. Refer to Section 05 12 00.
- L. Provide support for utility meters in accordance with requirements of utility company.
- M. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood.
- N. Provide sediment trap at all equipment connections. Trap length shall be 6 inches minimum, 10 inches maximum. The cap at the bottom end shall be a minimum 4 inches above any surface. The cap shall be threaded and accessible.
- O. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09 90 00.
- P. Install identification on piping systems including underground piping. Refer to Section 22 05 53.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.
- S. Install medium pressure gas pressure regulator with tee fitting between regulator and upstream shutoff valve. Cap or plug one opening of tee fitting.
- T. Install gas pressure regulator with tee fitting not less than 10 pipe diameters down stream

of regulator. Cap or plug one opening of tee fitting.

- U. Install gas pressure regulator with independent vent full size opening on regulator and terminate outdoors.
- V. Pipe on the roof shall be a minimum of 10 inches above the roof.
- W. Provide roof supports and penetration: Refer to Section 22 05 29.

3.07 SERVICE CONNECTIONS

- A. Coordinate with local gas utility company and pay all fees required to provide new gas service complete with gas meter and regulators. Gas service distribution piping to have initial minimum pressure as noted on Drawings.
- B. Install service regulator adjacent to building wall in specified location.
- C. Install pressure regulating valve and riser pipe to prevent undue stress upon service pipe. For plastic service pipe, use steel pipe riser from below ground to regulator.
- D. Install regulator vent with rain and insect proof opening, terminating away from building openings.
- E. Install gas pressure regulator with tee fitting between regulator and upstream shutoff valve. Cap or plug one opening of tee fitting.
- F. Install gas pressure regulator with tee fitting not less than 10 pipe diameters downstream of regulator. Cap or plug one opening of tee fitting.
- G. Branch saddle or service saddles with tapping tee are allowable at taps on existing mains.

3.08 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements: Field inspecting, testing, adjusting and balancing.
- B. Pressure test natural gas piping in accordance with NFPA 54.
- C. Inspect, test and purge gas piping in accordance with NFPA 54 and the local gas company requirements.
- D. When pressure tests do not meet specified requirements, remove defective work, replace and retest.

3.09 PAINT

- A. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09 90 00. All exposed gas piping shall be painted safety yellow, unless noted otherwise in Section 09 90 00.

END OF SECTION

SECTION 22 34 00 – FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Commercial gas-fired water heaters.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.
2. Section 22 07 00 - Plumbing Insulation: Field applied insulation for domestic water heaters.
3. Section: 22 11 00 - Facility Water Distribution: Supply connections to domestic water heaters.
4. Section 22 17 00 - Facility Natural-Gas Piping: Execution requirements for gas piping connections specified by this section.
5. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI Z21.10.3 - Gas Water Heaters - Vol. III Storage, with Input Ratings Above 75,000 Btu per Hour, Circulating and Instantaneous Water Heaters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. American Society of Mechanical Engineers:

2. ASME PTC 25 - Pressure Relief Devices.
3. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.

D. International Association of Plumbing and Mechanical Officials:

1. Uniform Plumbing Code

E. International Code Council:

1. International Fuel Gas Code.
2. International Energy Conservation Code.

3. International Plumbing Code
- F. National Fire Protection Association:
4. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
 5. NFPA 54 - National Fuel Gas Code.
 6. NFPA 58 - Liquefied Petroleum Gas Code.
- G. United States Department of Energy:
7. DOE 10 CFR - Uniform Test Method for Measuring the Energy Consumption of Furnaces.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.
- C. Product Data: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Submit data of flue and intake piping and condensate neutralization components. Indicate electrical power requirements and characteristics and connection locations.
- D. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.05 QUALITY ASSURANCE

- A. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1 when tested in accordance ANSI Z21.10.3.
- B. Perform all Work in accordance with local code authority and in accordance with manufacturer's installation instructions.
- C. Where heaters are classified as Boilers by the Texas Department of Licensing and Regulation (TDLR), installation shall meet all requirements of the Texas Boiler Rules. Coordinate with TDLR for inspection of completed Boiler installation and for Certificate of Operation prior to completion of project.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Products storage and handling requirements.
- B. Accept water heaters on site in original labeled cartons. Inspect for damage.
- C. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish three-year manufacturer warranty for domestic water heaters packaged water heating systems.

1.10 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.01 TANKLESS GAS FIRED WATER HEATERS

- A. Tankless gas fired water heaters shall be of the high efficiency condensing type. Capacities, etc. shall be as scheduled on the drawings. Heaters shall be CSA listed, exceed the energy efficiency requirements of ASHRAE 90.1b-2007, and shall comply with SCAQMD Rule 1146.2 Ultra-Low NOx Standards.
- B. Heaters shall be constructed with materials complying with the applicable Sections of NSF 61 and with ANSI 61-G and NSF 372 for lead free brass.
- C. The pressure rating shall be 125 psig minimum.
- D. Heaters, shall be a copper coil integral fin and tube construction with quick release brass or bronze waterways. Heaters shall be factory assembled and tested. The primary heat exchanger shall be constructed of HRS35 grade copper. The secondary heat exchanger shall be constructed of Type 316L stainless steel.
- E. The heater(s) shall be controlled by an onboard solid-state printed circuit board monitoring incoming and outgoing temperatures with factory installed thermistors,

sensing and controlling flow rate to set point temperature, controlling both air and gas mixture inputs to maintain thermal combustion efficiency. The heater(s) shall also consist of inline fusing, a spark ignition and sensor system, aluminized stainless steel burners, an air-fuel ratio sensor, a hi-limit temperature switch, modulating and proportional gas valves, a freeze protection sensor with ceramic heating blocks, and an overheat cutoff fuse.

- F. Heaters shall include a remote wall mount temperature controller with diagnostics for troubleshooting.
- G. Provide with the following accessories:
 - 1. Heavy duty forged brass Webstone EXP E3 Compact Isolator valves, that include valves and connections for draining and flushing of the heater, and ASME pressure relief valve sized for the heater capacity. Valves shall be constructed of lead free brass in accordance with ANSI 61-G and NSF 372.
 - 2. Pipe cover matching heater cabinet materials and finishes.
- H. Heater shall be compatible with recirculation pump.
- I. Acceptable Manufacturers:
 - 1. A.O. Smith
 - 2. Takagi
 - 3. Rinnai

2.02 CONDENSATE NEUTRALIZERS

- A. For Use with Commercial Boilers up to 199 MBtu/hr
- B. Clear Tube for Visual Inspection
- C. Integrated Unions with O-Rings
- D. Calcite and Magnesium Oxide Media
- E. Recharge Kits Sold Separately
- F. Includes PVC Adapters
- G. Includes Mounting Brackets for 2" Tube Style

PART 3 EXECUTION

3.01 GENERAL

- A. Install piping, etc. to allow easy removal of water heaters.
- B. Provide Condensate neutralization kit on discharge pipe form flue.
- C. Nameplate as required by and by Section 221000).

- D. Provide factory start-up for gas-fired water heaters. Start-up shall include performance tests of thermal efficiency and flue gas analysis. **Provide written report to A/E and include in Records for Owner.**

END OF SECTION

SECTION 22 40 00 – PLUMBING FIXTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Water closets.
2. Urinals.
3. Lavatories.
4. Sinks.
5. Service sinks.
6. Electric water coolers.
7. Showers.

B. Related Sections:

1. Section 07 90 00 – Joint Protection: Product requirements for caulking between fixtures and building components for placement by this section.
2. Section 22 00 01 – General Plumbing Requirements.
3. Section 22 11 00 – Facility Water Distribution: Supply connections to plumbing fixtures.
4. Section 22 13 00 – Facility Sanitary Sewerage: Waste connections to plumbing fixtures.
5. Section 26 05 03 – Equipment Wiring Connections: Execution requirements for electric connections to sensor valves and faucets specified by this section.

1.02 REFERENCES

A. American National Standards Institute:

1. ANSI A117.1 – Accessible and Usable Buildings and Facilities.
2. ANSI Z124.1 – Plastic Bathtub Units.
3. ANSI Z124.2 – Plastic Shower Units.
4. ANSI Z358.1 – Emergency Eyewash and Shower Equipment.

B. Air-Conditioning and Refrigeration Institute:

1. ARI 1010 – Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
- C. American Society of Mechanical Engineers:
 1. ASME A112; Plumbing Fixture Standards
- D. National Sanitation Foundation
 1. NSF/ANSI 61: Drinking Water System Components- Health Effects for fixtures material that will be in contact with potable water.
- E. Texas Department of Licensing and Regulation, Texas Accessibility Standards of the Architectural Barriers Act, Article 9102, Texas Civil Statutes
- F. Americans with Disabilities Act, 28 CFR Part 35 Nondiscrimination on the Basis of Disability in State and Local Government Services, Final Rule, as published in the Federal Register
- G. ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities" relative to plumbing fixtures for people with disabilities
- H. Texas Administrative Code, Title 30, Part 1, Chapter 290, Subchapter G - Water Saving Performance Standards.
- I. Refer also to plumbing drawing P1.1 for applicable codes.

1.03 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal procedures.
 1. Submittal shall have all options and all intended included items clearly identified on submittal.
- B. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim and finishes.
- C. Manufacturer's Installation Instructions: Submit installation methods and procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Record Documents:
 1. Provide full written description of manufacturer's warranty.
 2. Manufacturer's installation instructions.
- F. Operation and Maintenance Data:
 1. Include installation instructions, exploded assembly views, servicing requirements, inspection data, installation instructions, spare parts lists, replacement part numbers and availability, location and contact numbers of service depot, for all plumbing specialties installed.

G. Section 01 60 00 – Product Requirements; Substitution Request.

1. Prior to submitting a product or a manufacturer that is not the basis of design or listed as an approved equal; the contractor and/or the vendor shall submit a substitution request.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists. Provide contact number and location of supplier.

1.05 QUALITY ASSURANCE

- A. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.
- B. Fixtures, trim, accessories and carriers of any one type shall be by the same manufacturer throughout.
- C. All fixtures and trim shall be new, institutional/commercial quality and free from mars, chips, scratches, blemishes or any defects.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
- B. Accept fixtures on site in factory packaging. Inspect for damage
- C. Equipment, fixtures and appurtenances shall not be allowed to be exposed to exterior weather or elements. Equipment, fixtures and appurtenances stored outside shall be covered by a weather-proof covering at all times and shall be stored on pallets or rack systems above the ground. Equipment, fixtures and appurtenances stored inside shall be covered to protect same from construction debris and activities and shall be stored on pallets or rack systems above the floor. Equipment, fixtures and appurtenances shall not be allowed to be stored within the construction area in a disorderly fashion. Cleanliness of the work area and safety of the construction personnel shall be the first consideration.
- D. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
- E. Do not allow use of installed fixtures or trim, other than testing during construction phase of the project.

1.08 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish 1-year manufacturer warranty for plumbing fixtures. Warranty shall not begin until acceptance by Owner.

1.09 EXTRA MATERIALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall provide plumbing fixtures where indicated on the Drawings. These plumbing fixtures shall be standard products of manufacturers scheduled or listed on Drawings. Where one manufacturer is scheduled or listed on Drawings, the intent is not to limit competition or to write a closed specification, but rather to set a standard of quality. Refer to Section 01 60 00 for product options and substitution procedures. The fixtures shall be free from marks or chips and shall be new, first quality and shall be furnished with sufficient supports in order to adequately hang each and every unit.
- B. The space between fixtures and masonry walls shall be grouted with White General Electric Silicone flexible grout. The space between fixtures and sheetrock or wood panel walls shall not be grouted but the fixture shall fit flat against the wall surface with no more than 1/16" gap.
- C. All faucets, fittings, supply stops and similar devices shall be of one manufacturer unless otherwise specified. All water faucets and valve bodies shall be cast brass with a minimum copper content of 85%. They shall contain standardized interchangeable operating units constructed of a removable and replaceable unit containing all parts subject to wear. All water faucets shall contain an adjustable internal volume control unit. All exposed parts shall be chromium plated.
- D. All accessible fixtures shall meet the requirements of ADA, ANSI A117.1, ANSI Z124.2 and the State of Texas Accessibility Standards (TAS). The Contractor shall confirm locations with the Architectural drawings.
- E. Provide ADA/TAS compliant molded insulation on exposed water and drain components (piping, stops, etc.) beneath ADA accessible lavatories and sinks. Insulation shall be designed to allow removal and re-installation for pipe servicing. Insulation to be molded vinyl with added cushion and thermal resistance.
- F. Provide water hammer arrestors at all quick closing valves such as water closets, sensor faucets, knee or foot operated fixtures, etc.
- G. Coordinate special blocking, other wall supports, floor bracing or other structural bracing with General Contractor.
- H. Point of use thermostatic mixing valves located under sinks and lavatories shall be

secured to the wall with a mounting bracket and located under the sink. Supply hoses shall be ordered to the correct length. Excess supply hose shall be removed; wrapping excess supply tubing around other trim is not allowed.

- I. Any condensate connection to the tail piece shall be done with chrome plated brass or copper piping and held tight to the wall. Exposed Rubber hose will not be allowed. Coordinate with mechanical contractor.
- J. All fixtures and equipment shall be lead free and shall be assembled and manufactured with lead free solders in accordance with NSF-61-G and NSF 372.

2.02 FITTINGS AND PIPES

- A. Fittings and piping shall be brass and, wherever exposed, shall be polished chrome-plated. Provide tight fitting wall or floor escutcheons of chrome-plated brass wherever pipes pass through floors, walls or ceilings.
- B. Furnish and install all required water, waste, soil and vent connections to all plumbing fixtures, together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.
- C. Supplies for all lavatories, sinks, tank type water closets and drinking fountains shall be loose key angle stops with female inlets and shall include wall flanges, and O.D. flexible risers with bullnose or flared end outlets. All components to be chrome plated. In all cases, all piping, tubing, fittings, and faucets shall be installed using a mechanical non-slip connection, such as bullnose, flared, flanged, ferrule or threaded fittings. Fittings requiring a friction fit using slip-on or gasketed connections are not acceptable.
- D. Provide water hammers arrestors as indicated on the drawings and/or at all locations with quick closing valves such as water closets, automatic fixtures, knee operated or foot operated fixtures, ice makers, washer boxes, water softeners, etc.

2.03 PLUMBING FIXTURES

- A. Refer to Plumbing Fixture Schedules on the Plumbing drawings for basis of design fixtures and acceptable manufacturers offering equivalent products.
- B. All vitreous china shall be white unless noted otherwise
- C. Lavatory and sink faucets in patient care areas shall have a minimum of 5-inches clearance from the spout of the faucet to the rim of the sink per DSHS Licensing standards.
- D. Fixtures shall have flow control devices to limit flow of water to a maximum rate in accordance with local code or in accordance with the schedules for projects that require a more stringent water use criteria.

2.04 FLUSH VALVE WATER CLOSETS

- A. Water Closets:
 - 1. Complies with ASME A112.19.2

2. Tested by an independent MaP-approved laboratory, MaP tested and rated for a minimum of 350 grams or greater.
 3. The bowl shall be rated for a maximum of 1.26GPF unless noted otherwise.
- B. Exposed Flush Valve:
1. Complies with ASME A112.18.1 and ASME A122.19.2.
 2. Rated for a maximum 1.28-gallon flush volume unless noted otherwise. Flushvalve shall match the rating of the water closet.
 3. ADA compliant non-hold open handle, solid non-spinning escutcheon, comply with IAPMO/ANSI 2124.5-2013
 4. Water closet and urinal flush valves shall be chrome plated brass when exposed.
 5. All electronic flush valves shall be provided with manual override activators. Exception: Flush valves located within specimen collecting toilet rooms shall be hard wired without manual override.
- C. Seat:
1. Water closets seats shall be commercial/institutional grade, white in color, have open front and Self-sustaining check hinges with non-corrosive 300 series stainless steel posts and pintles
- D. Wall-Mounted Carrier: ASME A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, provide optional foot support, threaded fixture studs with nuts and washers.
- E. Water closet bowl gaskets shall be neoprene, felt gaskets and wax rings are not permitted.
- F. Bolts and fasteners shall be non-corrosive stainless steel 300 series.

2.05 WALL-HUNG URINALS

- A. Urinal:
1. Acceptable manufacturers offering equivalent products.
 - a. Kohler.
 - b. American Standard.
 - c. Zurn.
 2. ASME A112.19.2; floor-mounted, siphon jet vitreous china closet bowl, with elongated rim, 1-1/2-inch top spud, china bolt caps.
- B. Exposed Flush Valve:
1. Acceptable manufacturers offering equivalent products.

- a. American Standard.
 - b. Zurn.
 - c. Sloan.
2. ASME A112.18.1; exposed chrome-plated, diaphragm type with oscillating handle, escutcheon, seat bumper, integral screwdriver stop and vacuum breaker; maximum 1.6 gallon flush volume.
- C. Wall-Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.06 LAVATORIES

- A. Vitreous China Wall Hung Basin:
1. Acceptable manufacturers offering equivalent products.
 - a. Kohler.
 - b. American Standard.
 - c. Zurn.
 2. ASME A112.19.2; vitreous china wall-hung lavatory with 4-inch-high back, rectangular basin with splash lip, front overflow, and soap depression.
- B. Supply Fitting:
1. Manufacturer: As scheduled.
 2. Other acceptable manufacturers offering equivalent products.
 - a. Chicago.
 - b. T & S Brass.
 - c. Delta.
 3. ASME A112.18.1; chrome-plated supply fitting.
- C. Accessories:
1. Chrome plated 17-gage brass P-trap and arm with escutcheon.
 2. Offset waste with perforated open strainer.
 3. Screwdriver stops.
 4. Flexible supplies – Braiden 304 stainless steel; heavy duty plated brass nuts sized appropriately. No more than 3 inches of slack permitted.
- D. Wall-Mounted Carrier: ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, [threaded studs for fixture hanger,] [concealed arm supports,] bearing plate and studs.
- E. Counter-Mounted Basin:

1. Acceptable manufacturers offering equivalent products.
 - a. Kohler.
 - b. American Standard.
 - c. Zurn.
2. ASME A112.19.2; vitreous china wall-hung lavatory with 4-inch-high back, rectangular basin with splash lip, front overflow, and soap depression.

F. Supply Fitting:

1. Manufacturer: As scheduled.
2. Other acceptable manufacturers offering equivalent products.
 - a. Chicago.
 - b. T & S Brass.
 - c. Delta.
3. ASME A112.18.1; chrome plated supply fitting.

G. Accessories:

1. Chrome-plated 17 gage brass P-trap and arm with escutcheon.
2. Offset waste with perforated open strainer.
3. Screwdriver stops.
4. Flexible supplies – Braiden 304 stainless steel; heavy duty plated brass nuts sized appropriately. No more than 3 inches of slack permitted.

2.07 SINKS

A. Bowl:

1. Manufacturer: As Scheduled.
2. Other acceptable manufacturers offering equivalent products.
 - a. JUST.
 - b. Bradley.
 - c. Kohler.
3. ASME A112.19.3; 18-gage thick, Type 302 stainless steel, self-rimming and undercoated, with 1-1/2-inch chromed brass drain 3-1/2 inch crumb cup and tailpiece, ledge back drilled for trim.

B. Trim:

1. Manufacturer: As scheduled.

2. Other acceptable manufacturers offering equivalent products.
 - a. Chicago.
 - b. T & S Brass.
 - c. Delta.
3. Accessories: Chrome-plated 17-gage brass P-trap and arm with escutcheon, screwdriver stop, flexible supplies.

2.08 SHOWERS

A. Individual Wall Showers

1. Manufacturers: As Scheduled.
2. Construction: Shower panel is type 304 stainless steel polished to a #4 finish. All other exposed parts are stainless steel or chrome-plated brass. Valve bodies are brass casting. Supply inlets are flexible stainless-steel hoses.
3. Flow Control: A 2.0 GPM flow control is standard. (Actual flow may vary, but will not exceed 2.5 GPM Max.)
4. Shower Panel: Constructed of 18-gauge stainless steel polished to a #4 finish with stainless steel soap tray mounted to panel. Shower panel top and bottom covers are sloped, and constructed of 16-gauge stainless steel. Provide vertical shroud for supply piping.
5. Shower Head: Standard fixed direction adjustable spray showerhead with pressure balancing mixing valve.
6. Supply Inlets: Supply inlets are flexible, stainless steel hoses with 1/2 NPT connections. Inlets are accessible through the back of the shower or through knockouts in the top and bottom covers.

2.09 ELECTRIC WATER COOLERS

A. Fountain:

1. Manufacturer: As Scheduled.
2. Other acceptable manufacturers offering equivalent products.
 - a. Haws.
 - b. Elkay.
 - c. Halsey Taylor.
 - d. Oasis.

2.10 SERVICE SINKS

A. Bowl:

1. Manufacturer: As scheduled.
 2. Other acceptable manufacturers offering equivalent products.
 - a. Stern Williams.
 - b. Fiat.
 - c. American Standard.
- B. Trim:
1. Manufacturer: As Scheduled.
 2. Other acceptable manufacturers offering equivalent products.
 - a. American Standard.
 - b. T & S Brass.
 - c. Chicago.
 3. ASME A112.18.1 exposed wall type supply with lever handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges.
- C. Accessories:
1. 5 feet of 1/2 inch diameter plain end reinforced rubber hose.
 2. Hose clamp hanger.
 3. Mop hanger for min of 5 mops.

2.11 EMERGENCY EYE AND FACE WASH

- A. Manufacturers:
1. Bradley Corp.
 2. Haws Drinking Faucet Co.
 3. Guardian.

2.12 LAVATORY INSULATION KIT

- A. Manufacturers: As scheduled
1. Truebro.
 2. Substitutions: Permitted.
- B. Product Description: Where Lavatories are noted to be insulated for ADA compliance, furnish the following: Safety Covers conforming to ANSI A177.1 and consisting of insulation kit of molded closed cell vinyl construction, 3/16-inch thick, white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle

valve access covers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.02 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.
- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 09 90 00, color to match fixture.
- F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- G. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.04 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork Shop Drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.05 ADJUSTING

- A. Section 01 70 00 – Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING

- A. Section 01 70 00 – Execution and Closeout Requirements: Final cleaning.
- B. Clean plumbing fixtures and equipment.

3.07 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 – Execution and Closeout Requirements: Protecting installed construction.
- B. Do not permit use of fixtures before final acceptance.

3.08 SCHEDULES – REFER TO PLUMBING DRAWINGS

- A. Fixture Mounting Heights:
 - 1. Water Closet:
 - a. Standard: 15 inches to top of bowl rim.
 - b. Accessible: 18 inches to top of seat.
 - 2. Water Closet Flush Valves:
 - a. Standard: 11 inches min. above bowl rim.
 - b. Recessed: 10 inches min. above bowl rim.
 - 3. Urinal:
 - a. Standard: 22 inches to top of bowl rim.
 - b. Accessible: 17 inches to top of bowl rim.
 - 4. Urinal Flush Valves:
 - a. Standard: 48 inches max. above finished floor.
 - b. Accessible: 44 inches max. above finished floor.
 - 5. Lavatory:
 - a. Standard: 31 inches to top of basin rim.
 - b. Accessible: 34 inches to top of basin rim.
 - 6. Drinking Fountain:
 - a. Standard: 40 inches to top of basin rim.
 - b. Accessible: 36 inches to top of spout.
 - 7. Shower Heads:
 - a. Adult Male: 69.5 inches to bottom of head.
 - b. Adult Female: 64.5 inches to bottom of head.
 - c. Child: 58.5 inches to bottom of head.

8. Emergency Shower: Standard: TAS compliant.

END OF SECTION

SECTION 22 60 13 – MEDICAL GAS AND VACUUM SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Medical gas piping.
2. Valves.
3. Pipe hangers and supports.
4. Piping Specialties.
5. Oral evacuation pumps.
6. Gas cylinder manifold.
7. Labeling and identification.
8. Installer performed tests.
9. System verification tests.

B. Related Sections:

1. Section 03 30 00 – Cast-In-Place Concrete: Execution requirements for equipment bases specified by this section.
2. Section 07 84 00 – Firestopping: Product requirements for firestopping for placement by this section.
3. Section 08 71 00 – Door Hardware: Keying requirements for padlocks.
4. Section 22 05 03 – Pipes and Tubes for Plumbing Piping and Equipment: Product and installation requirements for piping materials applying to various system types.
5. Section 22 05 53 – Identification for Plumbing Piping and Equipment: Product requirements for underground pipe and valve identification for placement by this section.
6. Section 22 07 00 – Plumbing Insulation: Product and execution requirements for pipe insulation.
7. Section 22 11 00 – Facility Water Distribution: Product requirements for backflow preventers for placement by this section.
8. Section 26 05 03 – Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

9. Section 31 23 17 – Trenching: Execution requirements for trenching required by this section.
10. Section 31 23 23 – Fill: Requirements for backfill to be placed by this section.

1.02 REFERENCES

A. American Society of Mechanical Engineers:

11. ASME B16.18 – Cast Copper Alloy Solder Joint Pressure Fittings.
12. ASME B16.22 – Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
13. ASME B40.1 – Gauges – Pressure Indicating Dial Type – Elastic Element.
14. ASME Section VIII – Boiler and Pressure Vessel Code – Pressure Vessels.
15. ASME Section IX – Boiler and Pressure Vessel Code – Welding and Brazing Qualifications.

B. American Society of Sanitary Engineering:

1. ASSE 6010 – Professional Qualification Standard for Medical Gas and Vacuum System Installers.
2. ASSE 6030 – Medical Gas Verifiers Professional Qualification Standard.

C. American Welding Society:

1. AWS A5.8 – Specification for Filler Metals for Brazing and Braze Welding.
2. AWS B2.2 – Standard for Brazing Procedure and Performance Qualifications.
3. AWS D1.1 – Structural Welding Code – Steel.

D. ASTM International:

1. ASTM A269 – Standard Specification for Seamless and Welded Austenitic Stainless-Steel Tubing for General Service.
2. ASTM A395/A395M – Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
3. ASTM A403/A403M – Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
4. ASTM A536 – Standard Specification for Ductile Iron Castings.
5. ASTM A666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar.
6. ASTM B32 – Standard Specification for Solder Metal.

7. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
 8. ASTM B280 – Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 9. ASTM B819 – Standard Specification for Seamless Copper Tube for Medical Gas Systems.
 10. ASTM B828 – Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
 11. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 12. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 13. ASTM D2464 – Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 14. ASTM D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 15. ASTM D2467 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 16. ASTM D2564 – Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 17. ASTM D2855 – Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 18. ASTM F1476 – Standard Specification for Performance of Gasketed Mechanical
 19. Couplings for Use in Piping Applications.
- E. Compressed Gas Association:
1. CGA G-4.1 – Cleaning Equipment for Oxygen Service.
 2. CGA C-7 – Guide to the Preparation for Cautionary Labeling and Marking for Compressed Gas Containers.
 3. CGA V-1 – Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections.
 4. CGA V-5 – Diameter-Index Safety System (Non-Interchangeable Low-Pressure Connections for Medical Gas Applications).
- F. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 – Pipe Hangers and Supports – Materials, Design and Manufacturer.

2. MSS SP 67 – Butterfly Valves.
 3. MSS SP 69 – Pipe Hangers and Supports – Selection and Application.
 4. MSS SP 73 – Brazed Joints for Wrought and Cast Copper Alloy Solder Joint Pressure Fittings.
 5. MSS SP 110 – Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- G. National Electrical Manufacturers Association:
1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. National Fire Protection Association:
1. NFPA 99 – Health Care Facilities.
- I. Underwriters Laboratories Inc.:
1. Electrical Construction Equipment.

1.03 SYSTEM DESCRIPTION

A. Definitions

1. The following definitions are taken from NFPA 99, Chapter 3 Definitions. Retain in project specification or use to help edit the specification.
 - a. Category 2 Medical Piped Gas and Vacuum Systems: Systems where interruption would place patients at manageable risk.

B. Piping Systems:

1. Category 2 positive pressure medical gas system piping.
2. Category 2 medical-surgical vacuum system piping.
3. Air compressor intake piping.
4. Vacuum pump exhaust piping.
5. Category 2 underground protector piping.
6. Medical air compressor service piping.
7. Relief valve vent piping.

C. Equipment:

1. Valve cabinets.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Indicate piping system schematic with electrical and connection requirements general assembly of components, mounting and installation details.
 - 2. Indicate general layout of control and alarm panels.
 - 3. Indicate detailed medical wall assembly drawings.
- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturer's catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturer's catalog information including load capacity.
 - 4. System Components: Submit manufacturer's catalog information including capacity, component sizes, rough-in requirements, and service sizes. When applicable, include electrical characteristics and connection requirements.
 - 5. Compressors: Submit type, capacity and performance characteristics. Include electrical characteristics and connection requirements.
 - 6. Vacuum Pumps: Submit type, capacity and performance characteristics. Include electrical characteristics and connection requirements.
- C. Component Data:
 - 1. Valve Boxes and Area Alarms: Provide table listing location of valves, area alarm; sizes and quantity of valves, area served.
 - 2. Master Alarm and Area Alarm: Provide table listing equipment or area served and all alarm points and gases.
- D. Qualifications Data: Submit documentation verifying qualifications for the following:
 - 1. Brazers and brazing procedures.
 - 2. Welders and welding procedures.
 - 3. Medical gas and vacuum system installer.
 - 4. System verifier.
- D. Samples: Submit one of each outlet and each valve, when requested.
- E. Manufacturer's Installation Instructions: Submit hoisting and setting requirements, starting procedures.

- F. Manufacturer's Certificate:
 - 1. Certify products meet or exceed specified requirements.
 - 2. Certify piping materials comply with CGA G-4.1 cleaning requirements.
- C. Manufacturer's Field Reports: Indicate systems are complete, zone valves installed, and alarm systems functional.
- D. Installer's Test Reports:
 - 1. Submit documentation indicating completion of Installer Performed Tests.
 - 2. Submit list of each test and when test was completed.
 - 3. Include documentation required by NFPA 99.
- E. Verifier's Test Reports:
 - 1. Submit testing and inspection report of System Verification Tests.
 - 2. Submit list of each test and when test was completed.
 - 3. Include documentation required by NFPA 99.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of equipment piping, valves, outlets and components.
- C. Operation and Maintenance Data: Submit assembly views, lubrication instructions, replacement part numbers and availability.

1.06 QUALITY ASSURANCE

- A. Furnish piping, valves, pipe fittings, outlets and other piping components cleaned for oxygen service by manufacturer in accordance with CGA G-4.1.
- B. Furnish documentation certifying installed piping materials comply with CGA G-4.1 cleaning requirements.
- C. Perform Work in accordance with NFPA 99 for installation of piping systems and ASME Section IX and AWS B2.2 for brazing materials and procedures.
- D. Perform Work in accordance with authority having jurisdiction and AWS D1.1 for welding hanger and support attachments to building structure.
- E. Perform Work in accordance with State of Texas Hospital Licensing Standards.
- F. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years of documented experience.
 - 1. ASSE Standard 6010 qualified to install medical gas and vacuum systems.
- C. Brazers and Brazing Procedures: ASME Section IX or AWS B2.2 qualified within previous 12 months for medical gas and vacuum systems.
- D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months for medical gas and vacuum systems.
- E. System Verifier: Company specializing in performing medical gas system verification with minimum three years documented experience.
 - 1. ASSE Standard 6030 qualified and independent of system installer.

1.08 MOCK-UP

- A. Section 01 40 00 – Quality Requirements: Mock-up requirements.
- B. Construct mockup of outlets for each type of medical gas in typical patient head wall unit, when requested or indicated on Drawings.
- C. Incorporate accepted mock-up as part of Work or remove as directed by Architect/Engineer.

1.09 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. When required, convene minimum one week prior to commencing work of this section.
- C. When required, convene additional meetings minimum one week prior to commencing the following:
 - 1. Installer performed tests.
 - 2. System verification tests.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept equipment on site in factory fabricated containers with shipping skids and plastic pipe end protectors in place. Inspect for damage.
- C. Furnish temporary end caps and closures on piping and fittings. Maintain in place until

installation.

- D. Protect piping from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.11 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer warranty for pumps, compressors, refrigerated dryers and valves excluding packing.

1.12 MAINTENANCE SERVICE

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for maintenance service.
- B. Furnish service and maintenance of equipment and system for one year from Date of Substantial Completion.
- C. Examine equipment and system components monthly. Clean, adjust and lubricate equipment.
- D. Calibrate dew point alarms annually.
- E. Include systematic examination, adjustment and lubrication of equipment. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment.
- F. Perform work without removing equipment, system or components from service during building normal occupied hours or during maintenance period scheduled in advance with Owner.
- G. Provide emergency call back service at all hours for this maintenance period.
- H. Maintain locally, near Project location, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- I. Perform maintenance work using competent and qualified personnel under supervision of manufacturer or original installer.
- J. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

PART 2 PRODUCTS

2.01 CATEGORY 1 AND 2 POSITIVE PRESSURE MEDICAL GAS SYSTEM PIPING

- A. Piping All Sizes, Below Gauge Pressure of 185 psig:

3. Copper Tubing: ASTM B819, Type L, drawn. Furnish piping identified with manufacturer's markings.

- B. Piping 2-1/2 inches and Smaller, Above Gauge Pressure of 185 psi:
 - 1. Copper Tubing: ASTM B819, Type L, drawn. Furnish piping identified with manufacturer's markings.
- C. Piping 3 inches and Larger, Above Gauge Pressure of 185 psi:
 - 1. Copper Tubing: ASTM B819, Type K, drawn. Furnish piping identified with manufacturer's markings.
- D. Fittings: ASME B16.22, wrought copper and bronze or MSS SP 73 wrought and cast copper.
- E. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

2.02 CATEGORY 1 AND 2 MEDICAL-SURGICAL VACUUM SYSTEM PIPING

- A. Copper Tubing: ASTM B88, ASTM B280 or ASTM B819, Type L, drawn.
 - 1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.
 - 3. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

2.03 CATEGORY 1 AND 2 UNDERGROUND PROTECTOR PIPING

- A. PVC Pipe: ASTM D1785, Schedule 80, polyvinyl chloride (PVC) material.
 - 1. Fittings: ASTM D2467, Schedule 80, PVC. Use only long radius elbows.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

2.04 RELIEF VALVE VENT PIPING

- A. Copper Tubing: ASTM B88, ASTM B280 or ASTM B819, Type L, annealed. Furnish piping identified with manufacturer's markings.
 - 1. Fittings: ASME B16.22, wrought copper and bronze or MSS SP 73 wrought and cast copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting temperature range 1190 to 1480 degrees F.

2.05 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Copper Piping: Class 150, bronze unions with [soldered] [brazed joints].

2. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
 3. PVC Piping: PVC.
- B. Flanges for Pipe 2-1/2 inches and Larger:
1. Copper Piping: Class 150, slip-on bronze flanges.
 2. PVC Piping: PVC flanges.
 3. Gaskets: 1/16-inch-thick preformed neoprene gaskets.
- C. PVC Pipe Materials: For connections to equipment and valves with threaded connections, furnish solvent-weld socket to screwed joint adapters and unions, or ASTM D2464, Schedule 80, threaded, PVC pipe.

2.06 BALL VALVES

- A. Manufacturers:
1. Beacon Medaes Products.
 2. Allied Health Care.
 3. Amico Corporation.
 4. Crane Valve, North America.
 5. Hammond Valve.
 6. Milwaukee Valve Company.
 7. NIBCO, Inc.
 8. Stockham Valves & Fittings.
 9. Substitutions: Section 01 60 00 – Product Requirements.
- B. [BA-1] 2 inches and Smaller: MSS SP 110, 600 psi non-shock working pressure, bronze, three-piece body, chrome-plated brass or bronze ball, full port, Teflon seats, blow-out proof stem, solder ends with extensions for brazing, [lever handle] [locking lever handle] [extended lever handle].
1. Furnish valves cleaned for oxygen service in accordance with CGA G-4.1 by manufacturer and labeled, sealed, and packed for shipping.
- C. BA-2 – 2 inches and Smaller: MSS SP 110, Class 150, bronze, three-piece body, Type 316 stainless steel ball, full port, Teflon seats, blow-out proof stem, solder or threaded ends, locking lever handle.
- D. Locks: Furnish padlock with keyway matching [existing keying system.] [cylinders specified in Section 08 71 00.]

2.07 BUTTERFLY VALVES

A. Manufacturers:

1. Crane Valve, North America.
2. Hammond Valve.
3. Milwaukee Valve Company.
4. NIBCO, Inc.
5. Stockham Valves & Fittings.
6. Substitutions: Section 01 60 00 – Product Requirements.

B. [BF-1] 2-1/2 inches and Larger: MSS SP 67, [Class 150] [Class 200] [Class 250] [_____].

1. Body: Cast or ductile iron, [wafer] [lug] [or] [grooved] ends, stainless steel stem, extended neck.
2. Disc: [Nickel-plated ductile iron] [Aluminum bronze] [Elastomer coated ductile iron] [Chrome-plated ductile iron] [or] [stainless steel].
3. Seat: Resilient replaceable [EPDM] [Buna N] [neoprene Viton].

C. [BF-2] 2 inches through 10 inches: 150 psi at 73 degrees F water temperature, maximum service temperature: 140 degrees F, [one-] [two-] piece body, ASTM D1784 PVC, lug type flange facing, disc encapsulated with EPDM, stainless steel shaft, locking lever handle.

D. Locks: Furnish padlock with keyway matching [existing keying system.] [cylinders specified in Section 08 71 00.]

2.08 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. Carpenter & Paterson Inc.
2. Creative Systems Inc.
3. Flex-Weld, Inc.
4. Globe Pipe Hanger Products Inc.
5. Michigan Hanger Co.
6. Superior Valve Co.
7. Substitutions: Section 01 60 00 – Product Requirements.

- A. Conform to MSS SP 58.
- B. Furnish hangers for copper piping system with copper finish and sized for copper pipe.

2.09 FLEXIBLE PIPE CONNECTORS

- A. Manufacturers:
 - 1. Flex-Hose Co., Inc.
 - 2. Flexonics.
 - 3. Flex-Weld, Inc./Keflex.
 - 4. The Metraflex Company.
 - 5. Twin City Hose, Inc.
 - 6. Substitutions: Section 01 60 00 – Product Requirements.
- B. inches and Smaller: Corrugated [bronze] [stainless steel] hose with single layer of [bronze] [stainless steel] exterior braiding, [Schedule [40] [80] black steel] [copper tubing] ends; maximum working pressure [170] [190] [] psig, threaded or soldered ends. Minimum burst pressure of 1000 psi.
 - 1. Furnish cleaned for oxygen service by manufacturer and labeled, sealed and packed for shipping.

2.10 PRESSURE GAUGES

- A. Manufacturers:
 - 1. Amico Corporation.
 - 2. Dresser Instruments, Dresser, Inc.
 - 3. Dwyer Instruments, Inc.
 - 4. H.O. Trerice Co.
 - 5. Weiss Instruments, Inc.
 - 6. Substitutions: Section 01 60 00 – Product Requirements.
- B. Gauge: ASME B40.1 Grade B with bourdon tube, rotary brass or copper alloy movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Type 316 stainless steel or copper alloy.
 - 3. Dial Size: 2-inch diameter.

4. Mid-Scale Accuracy: ± 1.5 percent of full scale at point of reading.
5. Scale Range Positive Pressure: Normal reading falls within middle 50 percent of scale.
 - a. Oxygen, Medical Air and Nitrous Oxide: 0 to 100 psig.
 - b. Instrument Air: 0 to 300 psig.
6. Scale Range Vacuum and Waste Anesthetic Gas Disposal: 0 to 29.9 inches Hg.
7. Scale: Both psi and kPa.
8. Furnish gauges with demand check fitting.
9. Furnish gauges cleaned for oxygen service by manufacturer and labeled, sealed, and packed for shipping.

2.11 UNDERGROUND PIPE MARKERS

- A. Manufacturers:
 1. Seton.
 2. Brady.
 3. Substitutions: Section 01 60 00 – Product Requirements.
- A. Plastic Ribbon Tape: Bright colored, continuously printed, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
- B. Trace Wire: Magnetic detectable conductor, [clear] [brightly colored] plastic covering, imprinted with "[Medical Oxygen Service] [Medical Gas Service] [_____]" in large letters.

2.12 LABELING AND IDENTIFICATION

- A. Furnish labeling and identification in accordance with NFPA 99.
- B. Pipe Labels:
 1. Furnish pipe labels or stenciling identifying the medical gas or vacuum system. Furnish with name of gas or vacuum system or chemical symbol.
 2. Furnish pipe labels with colors in accordance with NFPA 99.
 3. When gas system operates at other than standard pressures, include operating pressure in addition to gas name.
- C. Valve Labels:
 1. Label source valve, main line valve, riser valve and service valve in accordance with NFPA 99.

2. Furnish valve with name of gas or vacuum system or chemical symbol. Label with room or area served. Label with caution to not open or close valve in an emergency.
 3. When gas system operates at other than standard pressures, label valve with operating pressure in addition to gas name.
- D. Cylinders: Label cylinder contents in accordance with CGA C-7.
- E. Outlets and Inlets:
1. Furnish with name of gas or vacuum system or chemical symbol.
 2. When gas system operates at other than standard pressures, include operating pressure in addition to gas name.
- F. Alarm Panels:
1. Label indicating condition monitored.
 2. Label each panel for area of surveillance.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Prepare soldered joints in accordance with ASTM B828.
- B. Ream pipe and tube ends. Remove burrs.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment with flanges or unions.
- E. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps. TAPE OF ANY KIND IS UNACCEPTABLE.

3.03 INSTALLATION – INSERTS

- A. Provide inserts for placement in concrete forms.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, method of attachment shall be as approved by Structural Engineer.

3.04 INSTALLATION – HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with MSS SP 69.
- B. Install hangers and supports at maximum spacing in accordance with NFPA 99.
- C. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2-inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Support vertical piping at every floor; maximum 15 feet on center. Support riser piping independently of connected horizontal piping.
- G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- H. Install pipe hangers and supports in accordance with Section 22 05 29.

3.05 INSTALLATION – BURIED PIPING SYSTEMS

- A. Establish elevations of buried piping with not less than two ft of cover.
- B. Establish minimum separation of three from other services and piping.
- C. Excavate pipe trench in accordance with Section 31 23 17.
- D. Install pipe to elevation as indicated on Drawings.
- E. Install buried oxygen piping in protector piping.
- F. Place bedding material at trench bottom to provide uniform bedding for piping, Category bedding materials in one continuous layer not exceeding compacted depth; compact to 95 percent maximum density.
- G. Install pipe on prepared bedding.
- H. Route pipe in straight line.
- I. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- J. Install plastic ribbon tape continuous over top of pipe, buried 6 inches below finish grade, above pipe line; coordinate with Section 31 23 23 and 31 23 17. Refer to Section 22 05 53.

- K. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 31 23 23.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After pressure test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of pipe. Compact to 95 percent maximum density.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.

3.06 INSTALLATION – ABOVE-GROUND PIPING – MEDICAL GAS SYSTEMS

- A. Install medical gas systems in accordance with NFPA 99.
- B. Install vacuum pump exhaust with termination exterior to building with elbow turned down and screen on end of elbow.
- C. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
- D. Cut pipe and tubing accurately and install without springing or forcing.
- E. Slope piping in direction of flow.
- F. Make branch connections in accordance with NFPA 99.
- G. Pressure Gauges:
 - 1. Install at locations identified in NFPA 99.
 - 2. Install capable of being read from standing position.
- H. Install pressure gauges located downstream from source valve with demand check fitting.
- I. Install pipe sleeves where pipes and tubing pass through walls, floors, roofs and partitions. Refer to Section 22 05 29.
- J. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 07 84 00 and 22 05 29.
- K. Install pipe identification in accordance with this Section.
- L. Except where indicated or in flush wall-mounted cabinets, install manual shut-off valves with stem vertical and accessible for operation and maintenance.
- M. Install locks on valves.

3.07 LABELING AND IDENTIFICATION

- A. Piping:
 - 1. Install pipe labels at intervals of not more than 20 feet.
 - 2. Install minimum of one pipe label in each room.
 - 3. Install label on each side of wall when penetrated by piping.
 - 4. Risers: Install minimum of one label for each story traversed by piping.
- B. Label gas cylinders with either labels or stencils naming contents in accordance with CGA C-7.

3.08 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements and Section 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
 - B. Installer Performed Tests – Category 1 and Category 2 Systems:
 - 1. Complete installer performed tests for each system in accordance with procedures specified in NFPA 99.
- System Verification Tests – Category 1 and Category 2 Systems:
- 1. Perform after completion of Installer Performed Tests.
 - 2. Conduct test by agency independent of system installer.
 - 3. Complete system verification tests for each system in accordance with procedures specified in NFPA 99.

3.09 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 – Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish initial start-up including routine servicing and checkout.

3.10 DEMONSTRATION

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate each piece of equipment operation and maintenance.

3.11 SCHEDULES

A. Valve Service:

SYSTEM DESCRIPTION	SHUTOFF
Instrument Air – Category 1 and 2	BA-1
Oral Evacuation	BA-2, BA-3, BA-4

B. Pipe Hanger Spacing:

PIPE HANGER SPACING		
PIPE SIZE Inches	MAXIMUM HANGER SPACING Feet	HANGER ROD DIAMETER Inches
1/2	6	3/8
3/4	7	3/8
1	8	3/8
1-1/4	9	3/8
1-1/2 and Larger	10	3/8

END OF SECTION

SECTION 23 00 01 – BASIC HVAC REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic HVAC Requirements specifically applicable to Division 23 sections, in addition to Division 1 - General Requirements.

1.02 REFERENCES

- A. All references in Division 23 to code standards or other publications shall be the latest edition/version, unless noted otherwise.

1.03 PLANS

- A. These specifications are accompanied by plans indicating typical layouts, pipe and equipment location, etc. The plans and these specifications are complimentary each to the other and what is called for by one shall be as binding as if called for by both. Should there be a conflict between Drawings and specifications regarding a material shown or work described or detailed then the material of work having the greater value shall be provided.
- B. The plans as prepared are in general diagrammatic. The contractor shall carefully lay out his work at the site to conform to the architectural, mechanical, electrical and structural conditions to provide grading of piping, to avoid all obstructions and to conform to details of installation as shown on the plans and supplied by the manufacturers of the equipment to be installed, and thereby to provide an integrated satisfactorily operating installation. **The General Contractor must coordinate the work of all trades.** All necessary offsets in piping, fittings, ductwork, etc. required to avoid interferences between piping, equipment, structural and architectural work are not shown but shall be furnished and installed by the Contractor without additional expense to the Owner.
- C. These specifications and plans accompanying same are intended to cover systems which will not interfere with the design of the building, which will fit into the available spaces, and which will insure complete and satisfactory systems. Each contractor shall, therefore, carefully examine the plans and the building and shall be responsible for the proper fitting of his material and apparatus into the building.
- D. The size of mechanical and electrical equipment indicated on the plans is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space with the manufacturer's recommended clearances allocated for same on the plans. It shall be the Contractor's responsibility to furnish data to evidence that sufficient space can be provided for the installation of proposed equipment and that adequate access will exist for servicing and maintenance of equipment. Should changes become necessary during construction, the contractor shall make such necessary changes at his (the Contractor's) own expense.
- E. Exceptions and inconsistencies in plans and specifications shall be brought to the Architect's attention no later than ten (10) days prior to the bid date, unless specified otherwise in Division 1. Otherwise, the Contractor shall be responsible for any and all changes and additions that may be necessary to accommodate his particular apparatus or equipment.

1.04 CHANGES

- A. Any changes from the plans necessary to make this work conform to the building as it is constructed, to make this work fit the work of other trades or to make this work conform to the rules of city and municipal bodies having jurisdiction shall be made by this contractor at no additional cost to the Owner. However, no changes shall be made from the work described on the plans and these specifications except on written order from the Architect/Engineer.
- B. If any changes are required other than those mentioned above and the changes involve extra work on the part of the Contractor, no charges for this extra work shall be allowed unless authorized in advance of the work by a written order from the Owner and/or Architect/Engineer stating the charges to be made for the work.
- C. Proposed use of item or equipment other than that specified or indicated may require redesign of structure, partitions, foundations, piping, wiring, or other parts of mechanical, electrical, or architectural layout. Redesign, new drawings, and detailing required shall be prepared and submitted to Architect/Engineer for approval.
- D. Where approved deviation requires different quantity, size and arrangement of wiring, conduit, equipment, etc. from that specified or indicated, provide such items and all other additional equipment required by system at no additional cost to the Owner.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Protection:
 - 1. All work, equipment and materials shall be protected at all time to prevent damage or breakage either in transit, storage, installation or testing. All openings shall be closed with caps or plugs during installation.
 - 2. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
 - 3. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Architect. In particular, ductwork insulation which becomes saturated will be rejected and must be removed from the job. Such repair or replacement shall be at no additional cost to the Owner.
 - 4. Protect interiors of new equipment, ductwork, and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
 - 5. Existing equipment, ductwork, and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
- B. Cleanliness of Piping, Ductwork, and Equipment Systems:
 - 1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and

welding of piping.

2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Clean interior of all tanks prior to delivery for beneficial use by the Owner.
4. Boilers shall be left clean following final internal inspection by the inspector.
5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.06 SUBSTITUTIONS

- A. The materials, products and equipment described and specified establish a standard of quality, function, dimension and appearance to be met by any proposed substitutions.
- B. Reference Section 01 60 00 – Product Requirements.
- C. Substitution requests are only required where specific manufacturers are listed or scheduled.

1.07 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. The Contractor shall furnish copies of the manufacturer's literature and drawings describing all proposed equipment and materials indicated in the specifications. The proposed use of the exact equipment and materials specified shall not change this requirement of including literature describing the proposed equipment. Manufactured items proposed for use, whether specified or proposed for substitution, shall be the current, catalogued product of the manufacturer, and replacement parts shall be available.
- C. Manufacturer's regular catalog sheets will not be acceptable under this requirement unless they indicate completely all of the specification requirements. Where drawings cover several sizes or types of construction they shall clearly indicate the size or type of construction to be used on the project. In cases where several sizes of the same type of equipment are required to be furnished, the submittal shall include a schedule identifying each piece of equipment, complete with all capacity information needed to compare every submitted item with its respective specified item. **Annotate to indicate exact model, size, and type submitted.**
- D. Brochures shall contain a certification that the equipment or materials are suitable for conditions shown and specified; that the equipment or materials are believed to be in conformity with the plans and specifications, except as may be specifically described and that approval is recommended. The certification shall be signed by the Contractor. Brochures received not in conformity with these requirements will be returned for required actions. Any deviation from the requirements of the specifications shall be clearly noted and marked for the Engineer's consideration.
- E. Approval of the brochures, or any part of the contents therein, shall not eliminate responsibility for compliance with the plans and specifications, unless specific attention has been called in writing to proposed deviations at the time of transmittal of the brochures and

such deviations have been approved, nor shall it eliminate the requirements or the responsibilities, if there are errors of any sort in the data submitted.

1.08 INTERFERENCES AND COOPERATION

- A. The plans are generally diagrammatic and the Contractor shall coordinate the work of the different trades so that interferences between piping, equipment, structural and architectural work will be avoided. Not all offsets in piping, ductwork, etc., are shown. The Contractor shall cooperate with the General Contractor and all other contractors to coordinate their work to avoid interferences and delays and arrange all parts of the work to harmonize in service and appearance with all other parts.
- B. The General Contractor shall coordinate the work of all trades. The various systems to be installed shall follow the normal, common sense priority of systems installation with the highest system to lowest system installation as follows:
1. HVAC ductwork shall be installed up and against building (floor/roof) structural members.
 2. Sanitary waste and storm drainage piping system shall begin horizontal routing as high as possible between structural members, offsetting vertically only to avoid conflict with structure or to drop below HVAC ductwork where offset is unavoidable.
 3. Electrical conduit shall be installed up, and against building structure, running parallel with HVAC ductwork and offsetting up into structural bay (void) or below HVAC ductwork to obtain a change in direction or branch take-off. Electrical conduit installation shall not control or dictate the routing or installation of the HVAC ductwork.
 4. Refrigerant piping, domestic hot and cold water supply and hot water circulating return piping, and medical gas piping shall be installed beside and below the HVAC ductwork and electrical conduit. Preferred installation shall be on trapeze, wall brackets, or racked on vertical channel on the wall above the ceiling line. The completed installation shall not conflict with the installation or removal of ceiling system components of tile. All main-run and branch take-off isolation valves shall be readily identifiable and accessible from a standing position on a step ladder.
 5. Fire sprinkler piping system shall be installed below all other systems and components. The fire sprinkler piping shall not conflict with the installation or removal of ceiling system components or tile. The fire sprinkler system piping layout and installation shall be coordinated by the fire sprinkler contractor and the General Contractor with all other trades performing work in the affected area, to avoid conflict with the installation or removal of any other systems components, or to prevent ready access to valves, equipment of the other trades. Do not install sprinkler piping until ductwork mains are in place.
- C. Provide an overhead coordination submittal per Section 01 30 00. The submittal shall include all structural, plumbing, mechanical, electrical and fire protection components.

1.09 MATERIALS AND WORKMANSHIP

- A. All materials shall be new, of the quality specified and free of any defects. Manufacturer's names are listed to establish a standard of quality and construction.

- B. The Contractor will be responsible for transportation of his materials to the job and for their storage and protection until the final acceptance of the job.
- C. Contractor shall furnish all necessary scaffolding, tackle, tools and appurtenances of all kinds and all labor required for the safe and expeditious execution of his contract.

1.10 PERMITS AND INSPECTIONS

- A. The Contractor will be responsible for all permits and inspections required by law for the completion of his work. Cost of all permits and inspections shall be paid for by the Contractor. The Contractor shall obtain and pay for all certificates of approval which must be delivered to the Architect before final acceptance of the job. All materials and labor furnished by the Contractor shall be in strict accordance with the rules and requirements of the National Board of Fire Underwriters, state and municipal regulations and other authorities who may have lawful jurisdiction over the work being done.
- B. Each contractor shall be responsible for coordinating their work with the General Contractor and scheduling AHJ required inspections through the General Contractor to allow inspections to be performed without impeding the progress of construction. Generally, the Contractor shall plan for inspections to occur two (2) weeks prior to the scheduled concealment of work in the area of inspection.

1.11 ENGINEERING DESIGN TEAM OBSERVATIONS

- A. Each contractor shall be responsible for coordinating their work with the General Contractor and scheduling progress observations through the General Contractor to allow for the following observations to be performed without impeding the progress of construction. Generally, the Contractor shall plan for observations to occur two (2) weeks prior to the scheduled concealment of work in the area of observation.
- B. In general, observations for this project shall include but not be limited to:
 - 1. Rough Wall: All utilities, services and systems in-place including wall studs, cross bracing, supports, etc. (No sheetrock or insulation).
 - 2. Corrected Rough Wall: (Before Sheetrock).
 - 3. Above Ceiling: All utilities, services and systems in place, labeling on exposed piping (No insulation on piping systems. Ceiling grid/channels may be installed but no sheetrock or ceiling tile).
 - 4. Above Ceiling Final: All utilities, services and systems complete including hangers, insulation, and labeling (ceiling grid and/or channel may be in place but no sheetrock or ceiling tile shall be installed).
 - 5. Substantial Completion: All surfaces complete, fixtures installed and trim-out complete.
 - 6. Final: Cleaned and ready for occupancy.

1.12 EXAMINATION OF SITE

- A. All Contractors submitting proposals for this work shall first examine the site and all

conditions thereon and therein. All proposals shall take into consideration conditions as may affect the work under this contract. They shall satisfy themselves as to existing grades and the actual formation, and soil conditions.

- B. Contractors shall verify all service locations, elevations, sizes, etc. No information given on the plans shall relieve the Contractor of this responsibility.
- C. Before starting work, the Contractor shall verify all associated existing systems, pipe and duct sizes, locations, and dimensions so that the new systems can be properly connected as indicated on the documents.

1.13 QUALITY ASSURANCE

- A. Perform Work in accordance with codes listed on the drawing sheets, the local authority having jurisdiction (AHJ), Owner, and the Architect/Engineer. As the minimum standard for the level of quality, in all cases the greater quantity or better quality shall be the first consideration for the basis of an acceptable product or process. The local authority having jurisdiction, Owner, and the Architect and the Engineer shall have the final authority on the approval and/or use of any product or process specified or submitted for substitution. The greater quality and/or value specified herein for the system(s) and various components and installation procedures shall take precedence over the minimum requirements of the herein before mentioned codes.
- B. Equipment and Components: Bear UL and FM label or marking.
- C. Welding Materials and Procedures: Perform to ASME Code.
- D. Valves: Bear UL/FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- E. Piping: All piping installed on this project shall bear the complete ASTM and Manufacturer's marking. Labeling and identification requirements as required by ASTM. All installed piping 5'-0" or greater in length shall be readily identifiable per ASTM labeling criteria. Piping not bearing this identification upon installation shall be removed and replaced by the correctly labeled piping. Piping shall not be re-stenciled after it is installed, to meet this requirement.

1.14 CONTROLS

- A. Where "automatic controls" are called for in the plans and specifications, all the control instruments, such as motorized valves, etc., shall be provided by the Contractor. The Drawings may show some power connections to controls equipment. However, if more power is required, then the Contractor shall provide this power.

1.15 UNIONS

- A. No unions are to be placed in any pipe in a location which will be concealed or inaccessible after completion of the building unless furnished with an access panel either as shown on the drawings or as specified herein. Unions must be installed on each side of all pieces of equipment such as heating/cooling equipment, coils, pumps, etc., so that such equipment may be readily disconnected in location that equipment can be disconnected and removed.

1.16 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork and equipment. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment layout drawings to coordinate proper location and personnel access of all facilities. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the drawings.
- C. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- D. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- E. Interconnection of Instrumentation or Control Devices: Generally, electrical and pneumatic interconnections are not shown but must be provided.
- F. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- G. Electrical and Pneumatic Interconnection of Controls and Instruments: This is generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Comply with NFPA-70.
- H. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

1.17 INDOOR AIR QUALITY CONTROL

- A. All Adhesives, sealants, paints, coatings applied within the weatherproofed interior of the building shall comply with applicable VOC thresholds of SCAQMD 1113 and 1168.

PART 2 PRODUCTS

2.01 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
 - 1. All components of an assembled unit need not be products of same manufacturer.
 - 2. Constituent parts that are alike shall be products of a single manufacturer.

3. Components shall be compatible with each other and with the total assembly for intended service.
 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

2.02 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.03 ESCUTCHEONS AND PLATES

- A. Where pipes or ducts pass through ceilings or walls in finished spaces, install sectional plates or escutcheons to cover the annular opening between pipe and sleeve. Solid plates with set screws shall be used where the sectional plates will not stay in place or are not available in the required size, or where other individual specification section(s) require one piece or greater quality escutcheons or plates.
- B. Inside diameter of escutcheons shall fit around insulation and around pipe or duct when not insulated; outside diameter shall cover sleeve. Secure escutcheons or plates to pipe or duct or sleeve but not to insulation. All escutcheons shall be triple nickel-chromium plated brass, or type 316L stainless steel.

2.04 INSULATION

- A. All insulation materials used inside the building on this project, including finishes and adhesives on the exterior surfaces of ducts, pipes and equipment shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less as determined by an independent testing laboratory in accordance with NFPA 255 as required by NFPA 90A, unless noted otherwise acceptable.

2.05 SOLENOID VALVES

- A. All solenoid valves used in hydronic systems shall be the slow acting type.

2.06 ASBESTOS

- A. Materials containing asbestos are not permitted.
- B. If any asbestos-containing material is discovered or suspected, the contractor shall immediately cease any and all work in that area. Cover the exposed material in plastic containment without disturbing the exposed material and notify the Architect and the

Owner's representative.

- C. Certify in writing that neither the Contractor nor any of Contractor's subcontractors or suppliers will supply any materials that contain any asbestos in any form for this Project.

PART 3 EXECUTION

3.01 ACCESS PANELS

- A. All valves, traps, drains, cleanouts, equipment, etc., must be accessible. The Contractor shall, wherever required to service his installation, coordinate size and location of access panels with General Contractor. Refer to Section 08 31 13 – Access Doors and Frames.

3.02 FIRESTOPPING

- A. Firestopping: Unused slots, sleeves and other penetrations in floors, walls or other general construction shall be closed and sealed with an approved firestopping material.
 - 1. Reference Section 07 84 00 – Firestopping for appropriate firestopping material required for each wall rating and penetration size and type.
 - 2. Openings in walls shall be closed with 16 gauge galvanized steel sheet securely attached at the midpoint of the wall thickness and firestopped on both sides of the steel sheet with not less than 1/8-inch thick layer of non-sagging silicone elastomer to fully cover the opening.
 - 3. Single or multiple pipes passing through walls and floors shall have the annular space between pipes or between pipes and structure filled with silicone elastomer to provide a rated firestop (rated to match the assembly) for floors and walls.
- B. Pipe and Ducts: The annulus between exposed pipe and ductwork and walls or floors in finished spaces shall be refilled, sealed and painted to match adjacent surfaces.
- C. Future Slots: Cap ends of sleeve and mark as future.

3.03 CUTTING AND PATCHING

- A. All cutting and patching of floors, walls and ceilings for installation of work covered in these sections will be done by the General Contractor.
- B. Where it becomes necessary to drill into or cut through any existing or completed floors, walls or ceilings to permit the installation of any work under this contract or to repair any defects that may appear up to the expiration of the guarantee, such cutting and patching shall be done by the General Contractor under the supervision of the Architect.
- C. No joists, beams, girders or columns shall be cut without first obtaining written permission from the Architect or Structural Engineer.
- D. Methods of cutting: Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations approved by the Architect/Engineer. Impact type equipment shall not be used except where specifically approved by the Architect/Engineer. Openings in precast concrete slabs for pipes, etc., shall be core drilled to exact size.

- E. Where core drilling or saw cutting of concrete floor or wall penetrations is required, work shall be performed in accordance with Division 03 Specifications. Where applicable Division 03 Specifications are not included in the Project, core drilling shall be in accordance with generally accepted standards and be performed by licensed personnel where applicable.
- F. Contractor shall use ground penetrating radar (GPR) to scan areas of concrete prior to core drilling or saw cutting for embedments. Contractor shall clearly mark locations of embedments for review by Structural Engineer or owner's construction representative before core drilling or saw cutting.
- G. Masonry: Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner approved by the Architect/Engineer.
- H. Plaster: All mechanical work in areas containing plaster shall be completed prior to the application of the finish plaster coat. Cutting of finish plaster coat will not be permitted.
- I. All drilling methods for expansion bolts, hangers and other supports shall be done subject to be approval of the Architect or Structural Engineer. Labor and materials required to replace or rebuild parts or injured portions shall be furnished at the Contractor's expense, subject to the satisfaction of the Architect.
- J. Restoration: All openings shall be restored to "as new" condition under the appropriate Specification Section for the materials involved, and shall match remaining surrounding materials and/or finishes.

3.04 PAINTING

- A. Types of paint shall be as specified in the Architectural specifications. Surfaces to be painted are identified in Section 09 90 00 and the drawings.
- B. All surfaces to be painted shall be thoroughly cleaned, all rust scraped off and all oil and grease removed before any paint is applied.
- C. Finishing paint coats shall not be applied until all the work is completed. Cloths shall be spread where necessary to prevent drops of paint, oil, etc. from defacing walls, floors, etc., and the Contractor shall be held responsible for all damage by neglect of such precautions. The finished conditions of the painting shall be subject to the approval of the Architect, who may require retouching or repainting of surfaces not properly finished.

3.05 RIGGING

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain

proper environment in the facility for Owner operation and maintenance of service.

- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Restore building to original condition upon completion of rigging work.

3.06 CLOSE OUT DOCUMENTATION AND TESTING REPORTS

- A. Contractor shall provide Project Record Documents, Operation and Maintenance data and all product warranty data as specified in Section 01 70 00.
- B. Contractor shall also provide copies of all piping and ductwork system test and certification reports for inclusion in project close out documents.

END OF SECTION

SECTION 23 05 13 – COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes single- and three-phase motors for application on equipment provided under other sections and for motors furnished loose to Project. These requirements shall apply unless otherwise noted within each equipment specification.
- B. Related Sections:
 - 1. Section 26 05 26 – Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 53 – Identification for Electrical Systems.
 - 3. Section 26 29 13 – Enclosed Controllers.

1.02 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- B. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 – Motors and Generators.
- C. International Electrical Testing Association:
 - 1. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.03 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog data for each motor furnished loose. Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.
- B. Testing Agency: Company specializing in testing products specified in this section with minimum ten years documented experience.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.

- B. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- C. Protect products from weather and moisture by covering with plastic or canvas and by maintaining heating within enclosure.
- D. For extended outdoor storage, remove motors from equipment and store separately.

PART 2 PRODUCTS

2.01 PRODUCT REQUIREMENTS FOR MOTORS

- A. Three-Phase Motors: NEMA MG 1, Design B, energy-efficient squirrel-cage induction motor, with windings to accomplish starting methods and number of speeds as indicated on Drawings.
 - 1. Voltage: As indicated on Drawings.
 - 2. Service Factor: 1.15
 - 3. Design for continuous operation in 40 degrees C environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Insulation System: NEMA Class B or better.
 - 5. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 - 6. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
 - 7. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
 - 8. Sound Power Levels: Conform to NEMA MG 1.
- B. Single Phase AC Induction Motors:
 - 1. Permanent split-capacitor type where available, otherwise use split-phase start/capacitor run or capacitor start/capacitor run motor.
 - 2. Motor shall be permanently lubricated, heavy duty ball bearing type.
 - 3. Voltage: As indicated on Drawings.
- C. Brushless DC Motor/Electronically Commutated Motor (EC motor):
 - 1. Internal motor circuitry shall convert supplied AC power to DC power to operate the motor.

2. Motors are permanently lubricated, heavy duty ball bearing type to match the equipment load.
 3. Motor shall be speed controllable down to 20% of full speed. Speed shall be controlled by either a dial-mounted potentiometer at the motor or a 0-10 VDC signal. Refer to Drawings for specific requirements.
 4. Motor shall be a minimum of 85% efficient at all speeds.
 5. Voltage: As indicated on Drawings.
- D. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.
- E. Motor Enclosure: meet conditions of the installation unless noted otherwise on the Drawings.

2.02 SOURCE QUALITY CONTROL

- A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- B. Install in accordance with manufacturer's instructions.
- C. Ground and bond motors in accordance with Section 26 05 26.
- D. Verify that speed control method for brushless DC/electronically commutated motors (ECMs), is provided as scheduled in the Drawings.

3.02 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements, 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Perform inspections and tests listed in NETA ATS, Section 7.15.

END OF SECTION

SECTION 23 05 29 – HANGERS AND SUPPORTS FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

- A. Perform all Work required to provide and install supports, hangers, anchors, sleeves and bases for all plumbing piping, equipment, system components and accessories, indicated by the Contract Documents with all supplementary items necessary for complete, code compliant and approved installation.
- B. Section Includes:
 - 1. Hangers and supports.
 - 2. Accessories.
 - 3. Flashing.
 - 4. Equipment curbs.
 - 5. Formed steel channel.
 - 6. Equipment bases (housekeeping pads).
 - 7. Exterior pipe supports
 - 8. Roof pipe chase housing
- C. Related Sections:
 - 1. Section 03 30 00 – Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
 - 2. Section 07 84 00 – Firestopping: Product requirements for firestopping for placement by this section.
 - 3. Section 07 62 00 – Sheet Metal Flashing and Trim: Product and execution requirements for sheet metal flashing and trim for placement by this section.
 - 4. Section 07 90 00 – Joint Protection: Product requirements for sealant materials for placement by this section.
 - 5. Section 09 90 00 – Painting and Coating: Product and execution requirements for painting specified by this section.
 - 6. Section 23 05 48 – Vibration for HVAC Piping and Equipment: Product and execution requirements for vibration isolators.
 - 7. Section 23 31 00 – HVAC Ducts and Casings: Execution requirements for placement of hangers and supports specified by this section.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.5 – Refrigeration Piping.

2. ASME B31.9 – Building Services Piping.
- B. ASTM International:
1. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials.
 2. ASTM E119 – Method for Fire Tests of Building Construction and Materials.
 3. ASTM E814 – Test Method of Fire Tests of Through Penetration Firestops.
 4. ASTM F708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.
 5. ASTM E1966 – Standard Test Method for Fire-Resistive Joint Systems
- C. American Welding Society:
1. AWS D1.1 – Structural Welding Code – Steel.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP 58 – Pipe Hangers and Supports – Materials, Design and Manufacturer.
 2. MSS SP 69 – Pipe Hangers and Supports – Selection and Application.
 3. MSS SP 89 – Pipe Hangers and Supports – Fabrication and Installation Practices.
 4. MSS SP 90 – Guidelines on Terminology for Pipe Hangers and Supports.
- E. Underwriters Laboratories Inc.:
1. UL 263 – Fire Tests of Building Construction and Materials.
 2. UL 723 – Tests for Surface Burning Characteristics of Building Materials.
 3. UL 1479 – Fire Tests of Through-Penetration Firestops.
 4. UL 2079 – Tests for Fire Resistance of Building Joint Systems.
 5. UL – Fire Resistance Directory

1.03 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturer's catalog data including load capacity.
- C. Design Data: Indicate when requested, load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- E. Manufacturer's Installation Instructions: Submit special procedures and assembly of components.
- F. UL/FM assembly sheets or WH assembly sheets for fire rated penetrations.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years of documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum 3 years of documented experience.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical and damage, by storing in original packaging.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements: Environmental conditions affecting products on site.

1.07 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.
- B. Contractor shall review all drawings, including structural drawings, for details regarding pipe supports, housekeeping pads, anchors, hangers, and guides.

1.08 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.01 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. Refer to individual system and equipment Specification Sections for additional support requirements. Comply with MSS SP-69 for support selections and applications that are not addressed within these Specifications.
- C. Utilize hangers and supports to support systems under all conditions of operation, allowing free expansion and contraction, and to prevent excessive stresses from being introduced into the structure, piping or connected equipment.
- D. All pipe supports shall be of the type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.

- E. Design hangers to impede disengagement by movement of supported pipe.
- F. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping.
- G. Wire or perforated strap iron will not be acceptable as hanger material.
- H. Hanger rods shall be threaded on both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
- I. Fasteners requiring explosive powder (shooting) or pneumatic-driven actuation will not be acceptable under any circumstances.
- J. Nail drive anchors, plastic anchors or plastic expansion shields will not be permitted under any circumstances.
- K. Each hanger shall be properly sized to fit the supported pipe or fit the outside of the insulation on lines, hangers shall not penetrate insulation. Hangers shall bear on the outside of the insulation, which shall be protected by support shields as specified. For piping larger than 2", protect insulation from crushing by means of a section of rigid insulation to be installed at hanger points. Refer to Section 23 07 00.
- L. Hangers and clamps supporting and contacting individual non-insulated copper lines shall be copper or copper plated. Support individual non-insulated copper lines 4 inches and smaller with adjustable swivel ring hangers. Where non-insulated copper lines are supported on trapeze hangers or channels, the pipes shall be isolated from these supports with approved flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp. Plastic tape is not acceptable.
- M. Field fabricated supports shall be constructed from ASTM A36/A36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- N. Provide adjustable spring type hangers/isolators on all pipe hangers on the first 15 feet of pipe entering the building and where piping offsets vertically from one floor level to another.
- O. Provide adjustable spring type vibration isolation hangers for piping connected to isolated equipment (i.e. pumps, etc.). Refer to Section 23 05 48.
- P. Finishes:
 - 1. All ferrous hangers, rods, inserts, clamps, stanchions, and brackets on piping within interior non-corrosive environments, shall be dipped in Zinc Chromate Primer before installation. Rods may be galvanized or cadmium plated after threading, in lieu of dipping zinc chromate.
 - 2. All hangers and supports exposed to the weather, including roofs and building crawl space areas, shall be galvanized or manufactured from materials that will not rust or corrode due to moisture. All hangers and supports located within corrosive environments shall be constructed from or coated with materials

manufactured for installation within the particular environment.

- Q. Trapezes: Where multiple lines are run horizontally at the same elevation and grade, they may be supported on manufactured channel, suspended on rods or pipes. Trapeze members including suspension rods shall be properly sized for the quantity, diameters, and loaded weight of the lines they are to support.
- R. Vertical Piping:
1. Supports for vertical riser piping in concealed areas shall utilize double bolt riser clamps, with each end having equal bearing on the building structure at each floor level.
 2. Supports for vertical riser piping at floor levels in exposed areas (such as piping in mechanical rooms) shall be attached to the underside of the penetrated structure utilizing drilled anchors, two hanger rods (sized as specified), and socket clamp with washers.
 3. Two-hole rigid pipe clamps or four-hole socket clamps with washers may be used to support pipe directly from adequate structural members where floor-to-floor distance exceeds required vertical support spacing and lines are not subject to expansion and contraction.

2.02 HANGERS AND SUPPORTS

- A. Refrigerant Piping and Condensate Drain Piping:
1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods. At un-insulated piping provide clamp with a thermoplastic elastomer cushion insert similar to Unistrut's Cush-A-Clamp or equal.
 5. Wall Support: Steel channels with electro-galvanized clamps. At un-insulated piping provide clamp with a thermoplastic elastomer cushion insert similar to Unistrut's Cush-A-Clamp or equal.
 6. Vertical Support: Steel riser clamp.
 7. Floor Support: Steel channels with electro-galvanized clamps. At un-insulated piping provide clamp with a thermoplastic elastomer cushion insert similar to Unistrut's Cush-A-Clamp or equal.
 8. Copper Pipe Support: Copper-plated carbon-steel ring.
- B. Ductwork Supports:
1. All ductwork shall be supported in accordance with the "Hangers and Supports." Chapter of SMACNA "HVAC Duct Construction Standards - Metal and Flexible"

for the service involved unless indicated otherwise in on the drawings.

2. Hanger Spacing. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing. Install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection. Do not use wire to support ductwork.
3. Horizontal ducts supported using galvanized steel bands shall extend up both sides and onto the construction above, where they shall turn over and be secured with bolts and nuts fitted in inserts set in the concrete, bolted to angles secured to the construction above, or secured in another approved manner.
4. Horizontal Ducts Larger Than 40 Inches. Support horizontal ducts larger than 40 inches in their greatest dimension by means of hanger rods bolted to angle iron (or equivalent unistrut) trapeze hangers. Place supports on at least 8'0" centers according to the following:

Angle Length	Angle	Rod Diameter
4'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
6'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
8'-0"	2" x 2" x 1/8"	5/16"
10'-0"	3" x 3" x 1/8"	3/8"

5. Vertical Ducts. Support ducts to ensure rigid installation. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Fig. 4-7, Fig 4-8, Fig 4-9. Support vertical ducts where they pass through the floor lines with 1-1/2 inches x 1-1/2 inches x 1/4 inch angles. Support vertical duct drops more than 6 feet in length with angle iron frames attached to ducts. Provide additional supports for any vertical duct drop more than 20 feet at maximum 15 feet on center.
6. Note that not all hangers are shown on the drawings. The Contractor shall coordinate all hangers with the structure and other trades.

C. Terminal Units:

1. Terminal units weighing up to 150 pounds shall be supported by four (4) 1 inch wide sheet metal straps with ends turned under bottom of unit at all corners.
2. Each band shall be secured by not over 3/4 inch in length, 1/4 inch diameter sheet metal screws – two (2) on bottom of unit and one (1) on each side.
3. The other strap end shall be attached to the structure by 1/4 inch diameter threaded bolt into the concrete insert or into drilled-hole threaded concrete expansion anchor.
4. Where interference occurs, overhead of the box, not allowing direct vertical support by straps, provide trapeze channels suspended by 1/4 inch diameter galvanized threaded rods providing such channels do not block access panels of units.
5. Terminal units weighing more than 150 pounds shall be supported per the terminal unit manufacturer's installation instructions using threaded rod and hanger brackets located per manufacturer's drawing.

2.03 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded with adjusting and lock nuts.
- B. Pipe Shields: Provide pipe shields at each support location of insulated piping in accordance with insulation manufacturer's published recommendations. Install MSS SP-58, Type 39 protection shields, if insulation without vapor barrier is indicated. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Refer to Section 23 07 00 for addition data on insulation shields.
- C. Power-actuated fasteners (shooting) will not be acceptable under any circumstances.
- D. Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

2.04 FLASHING

- A. Metal Flashing: 24 gauge thick galvanized steel.
- B. Metal Counterflashing: 24 gauge thick galvanized steel.
- C. Lead Flashing:
 - 1. Waterproofing: 5 lb./sq. ft. sheet lead.
 - 2. Soundproofing: 1 lb./sq. ft. sheet lead.
- D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gauge minimum; 16 gauge at fire-resistant elements.

2.05 EQUIPMENT CURBS

- A. Standard curbs for roof-mounted equipment:
 - 1. Furnished with roof mounted equipment.
 - 2. Factory insulated with 1-1/2 inches, 3 lb. density rigid insulation.
 - 3. Constructed for the roof slope so that equipment is level.
 - 4. 24-inch-high, galvanized steel construction with sufficient structural capacity to accommodate the imposed load.
 - 5. Factory-installed 2" by 2" wood nailer.
 - 6. Provide rubber curb seal between unit and roof curb.
 - 7. Roof curb shall be compatible with the roof type.
 - 8. Where installed on a metal roof the curb shall match the metal roof profile.
 - 9. Where installed on a sloped roof structure the curb shall have an adjustable pitch to match the slope of the structure, so that the equipment is mounted level.
- B. Condensing units, heat pumps, and condensers, roof-mounted:

1. Curbs shall be as specified in Division 7. Where curbs are not specified in Division 7, furnish curbs equal to ThyCurb Model TEMS-3, 24 inches high. Each unit to be supported by a minimum of two equipment curbs.
 2. Secure units to curb with galvanized steel or stainless steel fasteners. Utilize galvanized steel or stainless steel ell brackets as required to allow for the fasteners to penetrate at the side of the curb and not the top.
- C. Vibration isolation curbs (VRF heat pumps):
1. Where specified, scheduled, or noted in the Drawings, a vibration isolation curb shall be furnished and installed for roof-mounted equipment.
 2. Curb shall match all requirements of "Standard curbs for roof-mounted equipment" above, where applicable.
 3. Curb assembly shall be designed for the equipment and curb to withstand 125 mph winds without the use of guy wires.
 4. Curb shall be equal to Thybar model "VibroCurb III" with 1" deflection spring isolators and weather seal. Isolators shall be designed specifically for the weight distribution of the equipment being supported/isolated.
 5. Curb shall have a solid sloped stainless steel top, EPDM flashing, and hat channels for mounting unit above surface.

2.06 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12 gauge roll formed ASTM A1011 SS Grade 33 structural steel channel, 1-5/8 inch by 1-5/8 inch minimum strut or stronger as required. with holes 1-1/2 inches on center.

2.07 EQUIPMENT BASES (HOUSEKEEPING PADS)

- A. Provide minimum 3-1/2 inch reinforced concrete pads with chamfered corners and equipment bases for all outdoor equipment on grade, floor mounted equipment in main central plant area, mechanical rooms, areas with floors below grade, penthouse equipment rooms, floor mounted air handling units, and where shown on Drawings.
- B. Refer to Section 03 30 00 for concrete requirements.
- C. Housekeeping pads shall extend minimum of 6 inches on all sides beyond the limits of the mounted equipment unless otherwise noted.
- D. Provide galvanized anchor bolts for all equipment placed on concrete pads or on concrete slabs of the size and number recommended by the equipment manufacturer.

2.08 EXTERIOR PIPE SUPPORTS

- A. The following exterior supports may be utilized as non-penetrating type roof supports or as grade mounted supports on concrete pads.
- B. Adjustable height, single pipe support for pipe sizes 3" and smaller: UV resistant, high density polypropylene, polycarbonate or fiberglass reinforced nylon base with support strut channel, threaded rod, nuts, washers and pipe clamp. All metal components to be

hot dipped galvanized or stainless steel.

1. PHP model PP10
 2. Miro Industries, Inc. model 2.5-SB-HCS
 3. Mapa model MS-12SA10
 4. Substitutions: Under provisions of Section 01 60 00.
- C. Adjustable height, single pipe support for pipe sizes 4" and larger: Two base type support system with UV resistant high density polypropylene, UV resistant polycarbonate or stainless steel bases. Provide with support hangers appropriate for the type of pipe as specified in this section. Provide with threaded rod, nuts and washers. All metal components, unless indicated otherwise, to be hot dipped galvanized or stainless steel.
1. PHP model PS-1-2
 2. Miro Industries, Inc. models 6-H, 8-H or 16-H as appropriate
 3. Mapa model MB series
 4. Substitutions: Under provisions of Section 01 60 00.
- D. Adjustable height, multiple pipe support: Two base type support system with UV resistant high density polypropylene, UV resistant polycarbonate or stainless steel bases. Provide with support hangers appropriate for the type of pipe as specified in this section. Provide with threaded rod, nuts and washers. All metal components, unless indicated otherwise, to be hot dipped galvanized or stainless steel.
1. PHP model PSE series
 2. Miro Industries, Inc. models 6-H, 8-H or 16-H as appropriate
 3. Mapa model MB series
 4. Substitutions: Under provisions of Section 01 60 00.

2.09 ROOF PIPE CHASE HOUSING

- A. Manufacturers:
1. Roof Penetration Housing, LLC: The Vault
 2. Substitutions: Under provisions of Section 01 60 00.
- B. Roof Pipe Chase Housing:
1. Constructed of heavy gage powder coated welded aluminum with stainless steel hardware consisting of three pieces, a removable vandal resistant lid, a middle housing and a wide flanged 14-inch-high curb.
 2. Size, unless noted otherwise on drawings:
 - a. Length: 20 ½ inches.
 - b. Width: 14 ½ inches.
 - c. Height: 12 inches.
 3. Exit seals to be of aluminum or stainless steel using SilX14 gasket seal. Each seal shall accommodate the specified size of the pipe, cable or conduit ranging in

size from .25 inches up to 7.09 inches OD.

- a. Where noted on the drawings, provide pipe chase housing prepped with a hole and cover plate for a GFCI outlet to be installed by the electrician.
 4. ICC-500 and FEMA 320/361 wind rated and rain tight.
 5. Furnish each unit with factory installed one-inch-thick insulation in the curb, housing and lid. Insulation to have a minimum R value of 4.3.
- C. Warranty:
1. The rooftop pipe chase housing shall carry an insured 20 year warranty accommodating multiple penetrations including piping and conduits.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

3.02 PREPARATION

- A. Do not drill or cut structural members, unless written permission is obtained from the Structural Engineer.
- B. All auxiliary steel required for supports, anchors, guides, etc. shall be provided by the Contractor unless specifically indicated to be provided by others.
- C. All supports shall be of type and arrangement to prevent excessive deflection, to avoid excessive bending stresses between supports, and to eliminate transmission of vibration.
- D. Contractor shall be responsible for structural integrity of all supports, anchors, guides, etc. All structural hanging materials shall have a minimum safety factor of 5 built in

3.03 INSTALLATION – GENERAL

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. Application, sizing and installation of piping, supports, anchors and sleeves shall be in accordance with manufacturer's printed installation instructions.
- C. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc. All piping shall be installed with due regard to expansion and contraction and the type of hanger method of support, location of support, etc. shall be governed in part by this Specification.
- D. Install hanger so that rod is vertical under operating conditions.

- E. Provide for vertical adjustments after erection and during commissioning, where feasible, to ensure pipe is at design elevation and slope.
- F. Install hangers and supports to allow controlled thermal movement of piping systems, permitting freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Supports hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system
- H. The load and spacing on each hanger and/or insert shall not exceed the safe allowable load for any component of the support system, including any concrete that holds the inserts. Reinforcement at inserts shall be provided as required to develop the strength required. Contractor shall be responsible for engaging a structural engineer as required for design and review at support systems.
- I. Do not hang pipe, duct or any mechanical item directly from a metal deck or locate on the bottom chord of any truss or joist unless approved by the Structural Engineer of Record.
- J. Piping and ductwork supports shall be independent from fire protection piping supports or supports for other trade. Combining supports is not permitted
- K. All supports shall be designed and installed to avoid interference with other piping, hangers, ducts, electrical conduit, supports, building structures, equipment, etc.
- L. All piping and ductwork supports shall be designed and installed to allow the insulation to be continuous through the hangers.
- M. Adjustable clevis hangers shall be supported at rods with a nut above and below the hanger.
- N. All hanger rods shall be trimmed neatly so that 1 inch of excess hanger rod protrudes beyond the hanger nut. In the event a rod is intentionally but temporarily left excessively long (for sloped or insulated lines for example), the Contractor shall take appropriate measures to protect the pipe or other materials from damage.
- O. Install hangers to provide minimum ½ inch space between finished covering and adjacent structures, materials, etc.

3.04 INSTALLATION – PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69 and MSS SP 89.
- B. Support horizontal piping as scheduled at end of this section.
- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Locate hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.

- F. Support vertical piping at every floor and at maximum 10' on center.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers or non-metallic coatings or inserts on attachments for electrolytic protection where attachments are in direct contact with copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- M. Insulated piping larger than 2" diameter shall be supported with inserts of the same thickness as the insulation, or with other approved methods. Refer to Section 22 07 00 – Piping Systems Insulation.
- N. Supports, hangers, anchors, and guides shall be fastened to the structure only at such points where the structure is capable of restraining the forces in the piping system.

3.05 INSTALLATION – ATTACHMENT TO STRUCTURE

- A. Hangers shall be attached to the structure as follows.
 - 1. Poured-In-Place Concrete: Where pipes and equipment are supported under poured in place concrete construction, each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters Laboratories, Inc. listed universal concrete insert placed in the form work before concrete is poured. Where inserts are placed in the bottom faces of concrete joists which are too narrow to provide adequate strength of concrete to hold the insert properly or where a larger insert would require displacement of the bottom joist steel, the hanger rod shall be suspended from the center of a horizontal angle iron, channel iron, I-beam, etc. spanning across two adjacent joists. The horizontal support shall be bolted to nonadjustable concrete inserts of the "spot" type, of physical size small enough to avoid the bottom joist steel.
 - 2. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods may be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size; each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently fixed thereto.
 - 3. Steel Beams: Where pipes and loads are supported under steel beams, approved type beam clamps shall be used.
- C. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.06 INSTALLATION – FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- C. Provide curbs for roof installations. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints. Provide continuous shims under curbs as required to install equipment level.
- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb

3.07 INSTALLATION – ROOF CURBS

- A. Install curbs in accordance with manufacturer's instructions and as indicated on Drawings.
- B. Coat nailing flange in contact with pressure-treated wood with bituminous paint or isolate flange from pressure-treated wood with a layer of APP or SBS underlayment or separation sheet specified in Division 6.
- C. Coordinate installation of components of this section with installation of roofing membrane and base flashings, as specified in Division 7.

3.08 INSTALLATION – SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling or wall, close off space between pipe or duct and adjacent work with firestopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install chrome plated steel or stainless steel escutcheons at finished surfaces.
- G. Where installed in fire rated wall, floors, etc., install in accordance with UL/FM or Warnock Hersey fire rated assembly instructions.
- H. Install sleeves for all piping passing through penetrations in floors, partitions, roofs, and walls. All penetrations shall pass through sleeves.
- I. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and

walls. Sleeves are not required for core-drilled holes.

- J. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- K. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

3.09 INSTALLATION – EQUIPMENT BASES AND SUPPORTS

- A. Provide concrete housekeeping pads, per requirements in Part 2 of this section.
- B. Install anchor bolts, and accessories for mounting and anchoring equipment. Foundation bolts shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of sufficient size to provide ½ inch clearance around bolt.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.
- D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.10 INSTALLATION – EXTERIOR PIPE SUPPORTS

- A. Install exterior pipe and duct supports and exterior walkways and access platforms per manufacturer's recommendations.
- B. Locate bases and support framing as specified herein. Provide complete and adequate support of all piping and ducts, whether or not all required devices are shown.
- C. The use of wood for supporting piping is not permitted.
- D. Install piping supports at spacing indicated in schedule at end of this section
- E. Spacing of duct supports shall be in accordance with SMACNA and where indicated on the drawings.
- F. Accurately locate and align bases.

1. Consult manufacturer of existing or new roofing system as to the type of isolation pads required between the roof and base.
 2. Set isolation pads in adhesive if required by manufacturer's instructions.
 3. Place bases on isolation pads.
 4. Adhere or mechanically attach if required by code.
 5. Where applicable, replace gravel around bases
- G. Use galvanized fasteners for galvanized framing and stainless-steel fasteners for stainless steel framing.

3.11 INSTALLATION – ROOF PIPE CHASE HOUSINGS

- A. Install in accordance with manufacturer's recommendations.
- B. Coordinate size of the exit seals with HVAC, plumbing, electrical and telecommunications contractor.
- C. All penetrations shall use the appropriate exit seal furnished by the manufacturer. All penetrations shall only pass through the housing portion of the assembly. Support each penetration within 12 inches of exiting the unit

3.12 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements and 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.13 CLEANING

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.14 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

3.15 SCHEDULES

- A. Copper and Steel Pipe Hanger Spacing:

PIPE HANGER SPACING		
PIPE MATERIAL	MAXIMUM HANGER SPACING (Feet)	MIN. HANGER ROD DIAMETER (Inches)

Copper Tube, 1-1/4 inches and smaller	6	3/8
Copper Tube, 1-1/2 thru 2-1/2 inches	8	1/2
Copper Tube, 3 inches and larger	10	5/8
Steel Pipe, 1-1/2 inches and smaller	8	3/8
Steel Pipe, 2 thru 3 inches	10	1/2
Steel Pipe, 4 inches and larger	12	5/8

Support all vertical piping at each floor level and at maximum 10 feet spacing.

END OF SECTION

SECTION 23 05 48 – VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Vibration isolators.

B. Related Sections:

1. Section 07 90 00 - Joint Protection: Product requirements for joint sealers specified for placement by this section.
2. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
3. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Requirements for sound and vibration measurements performed independent of this section.

1.02 REFERENCES

A. American Society of Heating, Refrigerating and Air Conditioning:

1. ASHRAE 2019 HVAC Applications Handbook, Chapter 49.

B. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

1.03 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.

D. Design Data: Submit calculations indicating maximum room sound levels are not exceeded.

E. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

F. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of hangers including attachment points.

1.05 QUALITY ASSURANCE

- A. Provide for vibration isolation supports for all equipment, piping and ductwork indicated herein. The transmission of perceptible vibration to occupied areas by equipment installed under this Contract will not be permitted. Install vibration isolators as specified herein or shown on the Drawings or otherwise required to prevent the transmission of vibration which would create objectionable noise levels in occupied areas.
- B. The vibration isolation supplier must be a firm capable of dealing effectively with vibration and noise characteristics effects and criteria; and one that can provide facilities and capabilities for measuring and evaluating the aforementioned disturbances.
- C. Provide vibration isolation devices, from a single manufacturer or supplier who will be responsible for complete coordination of all phases of this work.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.07 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.08 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.01 VIBRATION ISOLATORS

- A. Open Spring Isolators - Type A:
 - 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 - 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.

3. Spring Mounts: Furnish with leveling devices, minimum 0.25-inch-thick neoprene sound pads, and zinc chromate plated hardware.
 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
- B. Restrained Spring Isolators - Type B:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 3. Spring Mounts: Furnish with leveling devices, minimum 0.25-inch-thick neoprene sound pads, and zinc chromate plated hardware.
 4. Sound Pads: Size for minimum deflection of 0.05 inch; meet requirements for neoprene pad isolators.
 5. Restraint: Furnish mounting frame and limit stops.
- C. Closed Spring Isolators - Type C:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
 3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25-inch clearance.
- D. Restrained Closed Spring Isolators - Type D:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.

3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25-inch clearance and limit stops.
- E. Spring Hanger - Type E:
1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
 2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
 3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators.
 4. Misalignment: Capable of 20-degree hanger rod misalignment.
- F. Neoprene Pad Isolators - Type F:
1. Rubber or neoprene-waffle pads.
 - a. 30 durometer.
 - b. Minimum 1/2 inch thick.
 - c. Maximum loading 40 psi.
 - d. Height of ribs: not to exceed 0.7 times width.
 2. Configuration: 1/2-inch-thick waffle pads bonded each side of 1/4 inch thick steel plate.
- G. Rubber Mount or Hanger - Type G:
1. Molded rubber designed for 0.5 inches deflection with threaded insert.
- H. Glass Fiber Pads – Type H:
1. Neoprene jacketed pre-compressed molded glass fiber.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify equipment, ductwork and piping is installed before work in this section is started.

3.02 INSTALLATION

- A. Install isolation for motor driven equipment.
- B. Adjust equipment level.
- C. Install spring hangers without binding.
- D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- F. Provide pairs of horizontal limit springs on fans with more than 6-inch static pressure, and on hanger supported, horizontally mounted axial fans.
- G. Support piping connections to isolated equipment resiliently to nearest flexible pipe connector.
- H. Connect wiring to isolated equipment with flexible hanging loop.

3.03 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements, 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect isolated equipment after installation and submit report. Include static deflections.

3.04 SCHEDULES

- A. Equipment Isolation Schedule:

Isolated Equipment	Base		Isolator	
	Type	Thickness	Type	Min. Deflection
Mini-split Condensing Units	None	-	F	0.25 in.
VRF Heat Pump Units	None	-	A	1.0 in.
Suspended Fan Coil Units	None	-	E	0.5 in.
Ceiling Cassette Units	None	-	G	0.5 in.

END OF SECTION

SECTION 23 05 53 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Equipment markers.
 - 2. Pipe markers.
 - 3. Ceiling tacks.
- B. Related Sections:
 - 1. Section 09 90 00 - Painting and Coating: Execution requirements for painting specified by this section.
 - 2. Section 23 00 01 – Basic HVAC Requirements: requirements for excavating and backfilling.

1.02 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 – Scheme for the Identification of Piping Systems.
- B. American National Standards Institute:
 - 1. ANSI Z535.1 – Safety Color Standard.
 - 2. ANSI Z535.2 – Environmental and Facility Safety Signs.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturer's catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification. Submit a valve chart and schedule, including valve tag number, location, function and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.05 QUALITY ASSURANCE

- A. Conform to ASME A13.1 and ANSI Z535.1 for color scheme for identification of piping systems and accessories.
- B. Conform to ASME A13.1 for length of field and letter height for pipe markers.
- C. Conform to ANSI Z535.1 and ANSI Z535.2 for emergency operating information and warning signs.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years of experience.

PART 2 PRODUCTS

2.01 PIPE MARKERS

- A. General: Conform to ASME A13.1 for background and letter colors, length of color field and letter height.
- B. Self-Adhesive Pipe Markers: Flexible, indoor/outdoor grade vinyl with factory-applied pressure-sensitive adhesive. Provide with minimum 1-1/2 inch wide banding tape.
- C. Mechanically Applied Pipe Markers:
 - 1. For pipes with an overall diameter up to 6 inches, including insulation, provide semi-rigid plastic wrap around pipe marker that extends 360 degrees around the pipe at each marker location. The semi-rigid marker should include the legend and a directional flow arrow. Pipe size shall also be on label of all insulated pipes. The marker shall be supplied as a pre-tensioned device and be equipped with a 1/2 inch strip of adhesive on the inside to further secure the marker in a permanent position on vertical locations.
 - 2. For pipes with an overall diameter greater than 6 inches, including insulation, provide a semi-rigid plastic strap-on pipe marker with a height no less than 3 times the letter height. The marker shall include a legend and a directional flow arrow. Pipe size shall also be on label of all insulated pipes. Markers to be installed indoors shall be supplied with no less than two nylon straps to secure the marker in place. Markers to be installed outdoors shall be supplied with stainless steel or aluminum strapping.

2.02 CEILING TACKS

- A. Description: Steel with 3/4 inch diameter color coded head.
- E. Color code as follows:
 - 1. Green: Plumbing valves.

2.03 PLASTIC EQUIPMENT MARKERS

- A. General: Provide laminated plastic equipment markers for all scheduled items of mechanical equipment installed indoors.
- B. Size: Size laminated plastic markers not less than one inch in height and three inches in length with engraved lettering white on black not less than 1/4 inch in height. For larger pieces of equipment, size markers 1-1/2 inch in height by 4-1/2 inches long, of 3/32 inch laminated plastic melamine with white on black lettering engraved not less than 1/16 inch deep and 1/2 inch high.
- C. Attachment: Attach nameplates with rivets, stainless steel screws or bolts. On equipment such as tanks and pumps which cannot be drilled or pierced, attach nameplates with brass chains and "S" hooks.
- D. For HVAC equipment installed above ceiling, provide 3/4 inch by 2-1/2 inches laminate tags attached with adhesive to the ceiling grid below. All smoke dampers, fire dampers, VAV boxes, humidifiers, etc. shall be tagged.

2.04 ALUMINUM EQUIPMENT MARKERS

- A. General: Provide engraved anodized aluminum equipment markers for all scheduled items of mechanical equipment installed outdoors.
- B. Size: Size engraved aluminum markers not less than 1 inch in height and 3 inches in length with engraved lettering white on black background not less than 5/8 inch in height. For larger pieces of equipment, size markers 3 inches in height by 6 inches long, with lettering not less than 1 inch in height.
- C. Attachment: Attach nameplates with rivets, stainless steel screws or bolts. On equipment such as tanks and pumps which cannot be drilled or pierced, attach nameplates with stainless steel chains and "S" hooks.

2.05 DUCT MARKERS

- A. Provide plastic adhesive duct access door markers indicating item and associated equipment accessed, and appropriate safety and procedural information. (e.g. Fire Damper AHU-1).
- B. Provide plastic adhesive duct labels identifying duct service (e.g. RTU-# SA or EF#-Exhaust). For exposed ducts, text on labels shall be large enough to read from floor level.

PART 3 EXECUTION

3.01 GENERAL

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Install identifying devices after completion of coverings and painting.
- C. Install labels with sufficient adhesive for permanent adhesion. For unfinished canvas covering, apply paint primer before applying labels.
- D. Identify control panels and major control components outside panels with plastic nameplates.

3.02 CONCEALED VALVES AND EQUIPMENT

- A. Equipment Above Ceilings: Provide valve tagging and identification to equipment located above ceilings, such as variable air volume boxes, valves, traps and other items before the ceilings are installed.
- B. Finished Surfaces: Where identification is to be provided on surfaces which require insulation, painting and finishing, install identification after covering and painting is complete.
- C. Provide plastic nameplates adhered to the ceiling grid to locate valves, equipment, or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment. Label with tag of equipment. Where access panels are installed in gypsum ceilings for access to equipment, provide label at corner of

3.03 PIPING SYSTEM IDENTIFICATION

- A. Install pipe markers on all piping systems and include arrows to show the normal direction of flow. Where flow can be in both directions, arrows in both directions shall be displayed.
- B. Identify piping exposed to view and concealed by accessible ceilings, including hard ceilings provided with access panels. Identify piping outdoors, in crawlspaces, on roof, above grade and within parking structures. Only piping located within walls or inaccessible areas need not be identified.
- C. Locate pipe markers as follows:
 - 1. Every 15 feet on straight runs.
 - 2. At each valve and control device.
 - 3. At each branch or take-off. Provide flow arrows on the branch pipe as well as on the main on both sides of the branch.
 - 4. At any change in piping direction.
 - 5. Above and below every floor or roof penetration.
 - 6. On either side of every wall or partition. Ensure there is a minimum of one marker per pipe in every room.
 - 7. On either side of large obstructions, ductwork or equipment that piping passes above.
 - 8. At 5-foot intervals where piping is obscured by close proximity to walls or other pipes.
 - 9. Provide only one label per unit drain connection for condensate drain piping on roof.
- D. Install pipe markers so they are visible and legible from a normal standing position.
- E. Secure each end of self-adhesive pipe markers with a full wrap of banding tape of the same background color. Banding tape shall overlap itself a minimum of 3 inches.
- F. Provide mechanically applied pipe markers for all piping in mechanical rooms and

outdoors.

- G. Install detectable underground warning tape 12 inches below finished grade, directly above buried pipe. If piping is buried more than 36 inches below finished grade, then provide an additional continuous length of tape buried 12 inches above the piping.

3.04 VALVE IDENTIFICATION

- A. General: Provide a valve tag on every valve, cock and control device in each piping system. Exclude check valves, valves within factory-fabricated equipment units, and shut-off valves at HVAC terminal devices. List each tagged valve in valve schedule for each piping system. In existing buildings, coordinate valve tags and schedules such that no valve numbers are duplicated.
 - 1. Tagging Schedule: Comply with requirements of "Valve Tags" and "Valve Schedules and Frames" paragraph.
- C. Install valve schedule frames and schedules in machine rooms where indicated or where directed.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install equipment markers on or near each major item of mechanical equipment. Provide signs for the following general categories of equipment and operational devices:
 - 1. Heat pumps, condensing units, and motor-driven units.
 - 2. Rooftop units.
 - 3. Fans, fan-coil units, cassette units, wall-mounted units.
- B. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

3.06 DUCTWORK IDENTIFICATION

- A. Identify fire damper, smoke damper, fire/smoke damper, and grease duct access doors with duct access door markers.
- B. Identify ductwork at drop from roof-mounted equipment or at mechanical walls of interior equipment. Provide additional identification at every 50' of horizontal ductwork.

3.07 COLOR AND IDENTIFICATION SCHEDULE

- A. Provide all pipe labels and lettering of colors listed below:

<u>FLUID SERVICE TYPE</u>	<u>PIPE MARKER LEGEND</u>	<u>PIPE MARKER BACKGROUND / LETTERING COLOR</u>	<u>VALVE TAG LETTERING</u>
Condensate Drain	CONDENSATE DRAIN	Green/White	CD
Refrigerant Liquid	REFRIGERANT LIQUID	Yellow/Black	
Refrigerant Suction	REFRIGERANT SUCTION	Yellow/Black	

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Testing, adjusting, and balancing (TAB) of the air conditioning systems and related ancillary equipment will be performed by a technically qualified TAB Firm.
- B. TAB Firm shall be capable of performing the TAB services as specified in accordance with the Contract Documents, including the preparation and submittal of a detailed report of the actual TAB Work performed.
- C. TAB Firm shall check, adjust, and balance components of the air conditioning system which will result in optimal noise, temperature, and airflow conditions in the conditioned spaces of the building while the system equipment is operating economically and efficiently. This is intended to be accomplished after the system components are installed and operating as specified in the Contract Documents. It is the responsibility of the Contractor to place the equipment into service. Variable air volume and variable water flow systems shall be balanced in accordance with AABC Standard, Latest Edition or NEBB Standards for Testing, Adjusting, Balancing of Environmental Systems (Latest Edition).
- D. TAB Firm shall check, adjust, and balance all hydronic systems including pumps, water distribution systems, chillers, cooling towers, boilers, heat exchangers, coils, and related equipment.
- E. During the balancing process, as the TAB Firm discovers abnormalities and malfunctions of equipment or components, the TAB Firm shall advise the Contractor in writing so that the condition can be corrected by the Contractor prior to finishing the TAB scope of Work. Data from malfunctioning equipment shall not be recorded in the final TAB report.
- F. The TAB Firm shall make qualified personnel available to conduct spot verification with the Commissioning Agency after TAB has been completed.

1.03 TAB PROCUREMENT

- A. The TAB Firm shall be hired directly by Owner and shall report to and be paid by the Owner.

1.04 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

1. AABC - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
2. NEBB - National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
3. ASHRAE HVAC Applications Chapter 37: Testing, Adjusting and Balancing.
4. ANSI/ASHRAE Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Buildings, Heating, Ventilation, Air Conditioning and Refrigeration Systems.
5. CTI - Cooling Technology Institute CODE ATC-105.

1.05 QUALITY ASSURANCE

- A. TAB Firm shall have operated a minimum of five (5) years under TAB Firm's current name and shall be in good standing with the State of Texas, Franchise Tax Board. TAB Firm shall submit full incorporated name, Charter Number, and Taxpayer's I.D. Number for proper verification of TAB Firm's status.
- B. TAB Firm's personnel performing Work at the Project Site shall be either professional engineers or NEBB or AABC certified air and water balance technicians, who shall have been permanent, full time employees of the TAB Firm for a minimum of six (6) months prior to the start of Work for this Project.
- C. TAB firm shall have a background record of at least five (5) years of specialized experience in the field of air and hydronic system balancing and shall possess properly calibrated instrumentation.

1.06 CONTRACTOR SYSTEM PREPARATION AND COORDINATION

- A. The scope of the TAB work as defined herein is indicated in order that the Contractor and/or Mechanical Subcontractor will be apprised of the coordination, adjustment, and system modification which will be required under the project work to complete the Owner's requirements for final TAB.
- B. The Contractor shall allow sufficient funds in the project cost estimate and bid proposal to cover all work which may be required in the TAB phases as defined herein and as may be necessary for the preparation of mechanical systems for TAB work and completion of the TAB work as defined by the TAB firm.
- C. As a part of this Contract, the Contractor and/or Mechanical Subcontractor shall make any changes in the sheaves, belts, dampers, valves, pump impellers, etc. required for correct balance as required by the TAB firm, at no additional cost to the Owner.
- D. The Mechanical Subcontractor shall provide and coordinate services of qualified, responsible subcontractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the testing, adjusting and balancing period.
- E. In order that all systems may be properly tested, balanced, and adjusted as required herein by these Sections, the Contractor shall start-up and check-out all systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB. This length of time shall be acceptable to the Owner's Representative.

- F. Project contract completion schedules shall provide sufficient time to permit the completion of TAB services prior to commissioning and owner occupancy. Contractor shall develop the project schedules in close coordination with the TAB and commissioning agent. If HVAC functional testing will be performed as part of the commissioning process, TAB work must be completed prior to the start of functional testing. The contractor shall include adequate time for both TAB and functional testing prior to substantial completion.
- G. The Drawings and Sections have indicated valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor or the Inspector shall be corrected by the Contractor immediately so the balancing work can proceed.
- H. Contractor must ensure that the necessary systems are scheduled to be in operations for TAB firm so that the access for balancing to diffusers, dampers etc., is not restricted. Contractor must schedule and coordinate activities so that TAB firm is not restricted from performing work, including access to damper operators and air devices.
- I. The Contractor shall correct deficiencies in a timely manner and produce a signed copy of the deficiency lists to the Owner. At that time, the TAB firm will return and verify that the deficiencies are corrected.
- J. Contractor Responsibilities
1. The Contractor shall have the building and air conditioning systems in complete operational readiness, including proper inspections, testing, and startup of equipment and controls as required in other specifications. Complete operational readiness of the building requires that construction status of the building shall permit the closing of doors and windows, ceilings installed, etc., to obtain simulated or projected operating conditions.
 2. Contractor shall perform all other items as described hereinafter to assist the TAB Firm in performing the balancing, testing, and adjusting of the air, hydronic and laboratory systems. He shall promptly correct deficiencies of material and workmanship identified as delaying completion of TAB work. The items shall include the following.
 3. All equipment shall be started up in accordance with manufacturers recommendations and the requirements within each applicable specification.
 4. Air Distribution Systems:
 - a. Verify installation for conformity to design. All supply, return and exhaust ducts terminated.
 - b. Verify all volume, splitter, extractor and fire and smoke dampers properly located and functional. Dampers shall provide tight closure and full opening, smooth and free operation.
 - c. Verify all supply, return, exhaust, transfer grilles, registers, diffusers, HEPA fan filter units and terminal units installed, leak tested and operational.

- d. Verify air handling systems, units and associated apparatus, such as heating and cooling coils, filter sections, access doors, etc., shall be blanked and/or sealed to eliminate excessively by-pass or leakage of air.
 - e. Final clean filters shall be in place, coils shall be clean with fins straightened, bearings properly greased, belts shall be aligned and tightened, and the system shall be completely operational.
 - f. The Contractor shall verify that all systems are operating within the design pressure limits of the piping and ductwork.
 - g. Verify all fans (supply, return, relief and exhaust) operating and verified for freedom from vibration, proper fan rotation and belt tension; overload heater elements to be of proper size and rating; and clean filters installed.
 - h. All terminal units (VAV boxes, unit ventilators, etc.) shall be installed and functional (i.e. controls functioning and checked by Contractor).
 - i. Verify laboratory Control Systems (LCS) including fume hood (non-recirculating), lab exhaust and general exhaust valves and supply valves and exhaust fan makeup/bypass dampers are installed and operational.
5. Automatic Controls:
- a. The Control Contractor shall schedule a meeting with the Project Engineer, TAB firm and Owner's representative for a pre-submittal review to establish that their interpretation of the Automatic Controls Operation is correct.
 - b. Verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, dampers sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc. The Control Contractor shall provide two (2) sets of the necessary software and hardware to the TAB Firm for control systems verification.
 - c. Verify that all controlling instruments are calibrated and set for design operating conditions with the exception of room thermostats or sensors, which shall be calibrated at the completion of TAB services with cooperation between the TAB firm and Control Contractor.
 - d. The Control Contractor shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB agency that the Building Automation System is operational.
 - e. The Control Contractor shall provide technical support (technicians and necessary computers) to the TAB agency for a complete check of these systems.
- K. Tabulated Data. The motor amperages, voltages and overload heater size of each piece of electrically driven equipment, including exhaust fans, shall be recorded showing "actual" and "nameplate" data and submit to the owner prior to balancing.
- L. The Contractor and the suppliers of the equipment installed shall all cooperate with the TAB Firm to provide all necessary data on the design and proper application of the system components and shall furnish all labor and material required to eliminate any deficiencies or malperformance. Furnish a list of all motors with nameplate data and size of overload heater installed with motor amperage during operation.

- M. During the balancing the temperature regulation shall be adjusted for proper relationship between controlling instruments and calibrated by the Control Manufacturer using data submitted by the TAB Firm.
- N. It shall be the obligation of the Contractor to furnish or revise fan drives, sheaves, belts, dampers, etc., and/or motors if necessary, without cost to the Owner, to attain the specified air volumes.
- O. The Contractor shall assist the TAB Firm after occupancy of the building to ensure that satisfactory conditions are being maintained throughout and to satisfy any unusual condition.

1.07 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Within 60 days after award of contract, submit name of testing, adjusting and balancing agency for approval.
- C. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing and equipment data required. Include detailed procedures, agenda, sample report forms and Copy of NEBB Certificate of Conformance Certification.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting and balancing of systems and equipment to achieve specified performance.
- E. The activities described in this Section shall culminate in a report to be provided electronically to the Engineer, the Contractor and the Owner. Neatly type and arrange data. Include with the data, the dates tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken after all corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation. The intent of the report is to provide a reference of actual operating conditions for the Owner's operations personnel.
- F. All measurements and recorded readings (of air, water, electricity, etc.) that appear in the report must have been made at the Project Site by the permanently employed technicians or engineers of the TAB Firm.
- G. Submit draft copies of report for review prior to final acceptance of Project.
- H. Submit reports on electronic forms approved by the Owner and Architect/Engineer which will include the following information as a minimum:
 - 1. Title Page:
 - a. Company name.
 - b. Company address.
 - c. Company telephone number.
 - d. Project name.
 - e. Project location.
 - f. Project Manager.
 - g. Project Engineer.
 - h. Project Contractor.
 - i. Project identification number.

2. Summary Comments:
 - a. Notable characteristics of system.
 - b. Description of systems operation sequence.
 - c. Design versus final performance.
 - d. Summary of outdoor and exhaust flows to indicate building pressurization.
 - e. Nomenclature used throughout report.
 - f. Test conditions.

3. Instrument List:
 - a. Instrument.
 - b. Manufacturer.
 - c. Model.
 - d. Serial number.
 - e. Range.
 - f. Calibration date.
 - g. Test instrument purpose.

4. Fan Data (Supply and Exhaust):
 - a. Identification and location.
 - b. Manufacturer.
 - c. Model.
 - d. Air flow, design and actual.
 - e. Total static pressure (total external), design and actual.
 - f. Inlet pressure.
 - g. Discharge pressure.
 - h. Fan RPM.
 - i. Sheave Make/Size/Bore.

5. Air Handler Return Air/Outside Air Data (also provide all fan data noted above and coil data as noted below):
 - a. Identification and location.
 - b. Design return air flow.
 - c. Actual return air flow.
 - d. Design outside air flow.
 - e. Actual outside air flow.
 - f. Return air temperature.
 - g. Outside air temperature.
 - h. Required mixed air temperature.
 - i. Actual mixed air temperature.

6. Cooling Coil Data:
 - a. Identification number.
 - b. Location.
 - c. Service.
 - d. Manufacturer.
 - e. Air flow (CFM) design and actual.
 - f. Air pressure drop (in. w.g.), design and actual.
 - g. Entering air temperature (DB & WB), design and actual.
 - h. Leaving air temperature (DB & WB), design and actual.
 - i. Sensible Capacity (Btu/hr) design, and actual.
 - j. Total Capacity (Btu/hr) design, and actual.

7. Heating Coil Data:

- a. Identification number.
 - b. Location.
 - c. Service.
 - d. Manufacturer.
 - e. Air flow (CFM), design and actual.
 - f. Air pressure drop (in. w.g.), design and actual
 - g. Entering air temperature, design and actual.
 - h. Leaving air temperature, design and actual.
 - i. Heating Capacity (Btu/hr) design, and actual.
 - j. Electric heat kW, number of stages, kW per stage – design and actual (if applicable).
8. Electric Motors:
- a. Manufacturer.
 - b. Horsepower/brake horsepower.
 - c. Phase, voltage, amperage, nameplate, actual.
 - d. RPM.
 - e. Sheave Make/Size/Bore.
 - f. Service factor.
 - g. Starter size, heater elements, rating.
 - h. Variable speed drive settings (as applicable).
9. Air distribution system
- a. Air device number
 - b. Room number / location (include floor schematic floor plan with air device numbers marked)
 - c. Air device type
 - d. Air device size
 - e. Area factor
 - f. Design air flow and velocity
 - g. Test (final) air flow and velocity
 - h. Percent of design air flow
10. Air-cooled Condenser:
- a. Identification / number
 - b. Location
 - c. Manufacturer
 - d. Model number
 - e. Serial number
 - f. Entering DB air temperature, design and actual
 - g. Leaving DB air temperature, design and actual
 - h. Number of fans / motors
 - i. Fan motor data (volts, phase, amps)
11. Air-cooled Condensing Unit / Heat Pump Unit:
- a. Identification and location.
 - b. Service.
 - c. Manufacturer
 - d. Serial number
 - e. Entering DB air temperature, design and actual
 - f. Leaving DB air temperature, design and actual
 - g. Number of compressors
 - h. Compressor motor data (volts, phase, amps)
 - i. Condenser Fan motor data (volts, phase, amps)
 - j. Refrigerant type and charge.

12. Fan Coil Units/Cassettes/Wall-Mount Units:
 - a. Identification / number
 - b. Location
 - c. Manufacturer
 - d. Model number
 - e. Serial number
 - f. Size / capacity
 - g. Air flow, design and actual
 - h. Entering air temperature (DB & WB), design and actual.
 - i. Leaving air temperature (DB & WB), design and actual.
 - j. Fan motor data (HP, volts, phase, amps)
 - k. Fan RPM
 - l. For DX fan coil units, provide Refrigerant type and charge

13. Control verification indicating date performed and any abnormalities identified:
 - a. Point Location/Description.
 - b. EMS Readout (Setpoint and Actual).
 - c. Actual Readout.
 - d. Interlocks.
 - e. Safeties:
 - 1) VFD Normal Operation.
 - 2) VFD Bypass Operation.
 - f. Alarms.
 - g. Sequences of Operation.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
 1. Systems are started and operating in safe and normal condition.
 2. Temperature control systems are installed complete and operable.
 3. Proper thermal overload protection is in place for electrical equipment.
 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 5. Duct systems are clean of debris.
 6. Fans are rotating correctly.
 7. Fire, fire/smoke and volume dampers are in place and open.
 8. Air coil fins are cleaned and combed.
 9. Access doors are closed and duct end caps are in place.

- 10. Air outlets are installed and connected.
- 11. Duct system leakage is minimized.
- C. Report any defects or deficiencies noted during performance of services to Architect/Engineer.
- D. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
- E. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- F. Beginning of work means acceptance of existing conditions

3.02 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- H. Check and adjust systems approximately six months after final acceptance and submit report.

3.03 AIR SYSTEM PROCEDURE

- A. When systems are installed and ready for operation, the TAB Firm shall perform an air balance for all air systems and record the results.
- B. The outside, supply, exhaust and return air volume for each air handling unit, supply fan and exhaust fan and the supply, exhaust or return air volume for each distribution device shall be adjusted to the design values shown on the Drawings, within the specified tolerances.
- C. Air handling unit and fan volumes shall be adjusted by changing fan speed as first priority (with dampers open) and adjusting volume dampers associated with the unit as second priority.
- D. Air distribution device volume shall be adjusted using the air device branch takeoff

damper for flexible duct connected devices and the device opposed blade damper (OBD) for duct connected devices. Air distribution devices shall be balanced with air patterns as specified.

- E. Duct volume dampers shall be adjusted to provide air volume to branch ducts where such dampers are shown.
- F. The general scope of balancing by the TAB Firm shall include, but is not limited to, the following:
 - 1. Filters: Check air filters and filter media and balance only systems with clean filters and filter media. The Contractor shall install new filters and filter media prior to the final air balance.
 - 2. Blower Speed: Measure RPM at each fan or blower. Where a speed adjustment is required, the Contractor shall make any required changes.
 - 3. Ampere Readings: Measure and record full load amperes for motors.
 - 4. Static Pressure: Static pressure gains or losses shall be measured across each supply fan, cooling coil, heating coil, return air fan, air handling unit filter and exhaust fan. These readings shall be measured and recorded for this report at the furthest air device or terminal unit from the air handler supplying that device. Static pressure readings shall also be provided for systems, which do not perform as designed.
 - 5. Equipment Air Flow: Adjust and record exhaust, return, outside and supply air CFM(s) and temperatures, as applicable, at each fan, blower and coil.
 - 6. Coil Temperatures: Set controls for full cooling and for full heating loads. Read and record entering and leaving dry bulb and wet bulb temperatures (cooling only) at each cooling coil, heating coil and reheat coil at each VAV terminal unit. At the time of reading record water flow and entering and leaving water temperatures.
 - 7. Zone Air Flow: Adjust each HVAC VAV terminal unit and VAV air handling unit for design CFM.
 - 8. Outlet Air Flow: Adjust each supply diffuser, register and grille and each exhaust or return inlet to design air CFM., within specified tolerances. Include all terminal points of air supply and all points of exhaust or return.
 - 9. Ensure that all rooms or spaces designed to be negative pressure have an overall air balance of at least 5% negative; and all rooms or spaces designed to be positive pressure have an overall air balance of at least 5% positive.
 - 10. Pitot Tube Traverses: For use in future troubleshooting by Owner, all exhaust ducts, main supply ducts and return ducts shall have air velocity and volume measured and recorded by the traverse method. Locations of these traverse test stations shall be described on the sheet containing the data.
 - 11. Maximum and minimum air flow on terminal units.
 - 12. TAB shall provide a record of the variable volume system operating conditions at maximum and minimum design airflow including diversity and static pressure

setpoints.

13. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
14. Prepare schematic diagrams of systems' "as-built" duct layouts.
15. For variable-air-volume systems, develop a plan to simulate diversity.
16. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
17. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
18. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
19. Verify that motor starters are equipped with properly sized thermal protection.
20. Check dampers for proper position to achieve desired airflow path.
21. Check for airflow blockages.
22. Check condensate drains for proper connections and functioning.
23. Check for proper sealing of air-handling unit components.
24. Check for proper sealing of air duct system.
25. Perform TAB work to determine the proper relative air pressurization to outside on a per floor basis in order to prevent infiltration. Provide documentation of airflow setpoints and relative pressures.

G. Procedures for Constant-Volume Air Systems

1. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
2. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - e. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

- f. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - g. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - h. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
3. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
 5. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 6. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 7. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 8. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
 9. Measure terminal outlets and inlets without making adjustments:
 10. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
 11. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals:
 - a. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents and Specifications.
 - b. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.04 MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the data listed in section 1 of this specification.

- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.05 CONDENSING UNITS

- A. Verify proper rotation of fans. Measure data as indicated in section 1.

3.06 BUILDING AUTOMATION SYSTEMS

- A. In the process of performing the TAB Work, the Contractor shall:
 - 1. Work with the Building Automation System (BAS) Provider and Owner to ensure the most effective total system operation within the design limitations, and to obtain mutual understanding of intended control performance.
 - 2. Verify that all control devices are properly connected.
 - 3. Verify that the intended controllers operate all dampers, valves and other controlled devices.
 - 4. Verify that all dampers and valves are in the position indicated by the controller; open, closed, or modulating.
 - 5. Verify the integrity of valves and dampers in terms of tightness of close-off and full-open positions. This includes all duct-mounted dampers, dampers in terminal units, and fire/smoke dampers.
 - 6. Observe that all valves are properly installed in the piping system in relation to direction of flow and location. Observe that all pressure independent control valves are properly installed in accordance with manufacturer's published installation instructions.
 - 7. Observe the calibration and operation of all controllers.
 - 8. Verify the proper application of all normally opened and normally closed valves.
 - 9. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts, or cold walls.
 - 10. Observe the locations of all sensors to determine whether their position will allow them to sense only the intended temperatures or pressures of the media. BAS Provider will relocate sensors as deemed necessary by the TAB Firm or Contractor.
 - 11. Verify that the sequence of operation for any control mode is in accordance with approved Shop Drawings and Specifications. Verify that no demand for simultaneous heating and cooling occurs at the terminal units.
 - 12. Verify that all controller setpoints meet the Contract Documents.
 - 13. Check all dampers for free travel.
 - 14. Verify the operation of all interlock systems.

15. Perform variable volume system verification to assure the system and system components track with changes from full flow to minimum flow.

3.07 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 1. Air Outlets and Inlets: Plus or minus 10 percent.
 2. Air Handling Equipment and Fans: Minus 5 to plus 10 percent.

END OF SECTION

SECTION 23 07 00 – HVAC INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Piping - Cellular Foam.
2. Piping – Jackets.
3. Ductwork – Glass Fiber, Flexible.

B. Related Sections:

1. Section 07 84 00 – Firestopping: Product requirements for firestopping for placement by this section.
2. Section 09 90 00 – Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.
3. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment: Product and Execution requirements for inserts at hanger locations.
4. Section 23 05 53 – Identification for HVAC Piping and Equipment: Product requirements for HVAC piping and equipment identification.
5. Section 23 31 00 – HVAC Ducts and Casings.

1.02 REFERENCES

A. ASTM International:

1. ASTM A167 – Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM C177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
4. ASTM C195 – Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449/C449M – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C518 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
7. ASTM C533 – Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

8. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
9. ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation.
10. ASTM C552 – Standard Specification for Cellular Glass Thermal Insulation.
11. ASTM C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
12. ASTM C591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
13. ASTM C592 – Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).
14. ASTM C610 – Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
15. ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
16. ASTM C795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
17. ASTM C921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
18. ASTM C1071 – Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
19. ASTM C1126 – Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation.
20. ASTM C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
21. ASTM C1290 – Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
22. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
23. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
24. ASTM E90-09 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
25. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
26. ASTM E2336 – Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems Acceptance Criteria for Grease Duct Enclosures.
27. ASTM E162 – Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
28. ASTM E1222-90 - Standard Test Method for Laboratory Measurement of the

Insertion Loss of Pipe Lagging Systems

29. ASTM F1249 -- Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
 30. ASTM G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 31. ASTM D5590 -- Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.
- B. Sheet Metal and Air Conditioning Contractors':
1. SMACNA – HVAC Duct Construction Standard – Metal and Flexible.
- C. Greenguard Environmental Institute:
1. GEI - Greenguard Certification Standards for Low-Emitting Products.
- D. South Coast Air Quality Management District:
1. SCAQMD Rule 1168 – Adhesive and Sealant Applications, including all amendments through October 2017
 - a. PVC welding: Maximum VOC content 510 g/L.
 - b. Adhesive primer for plastic: Maximum VOC content 550 g/L.
 - c. Contact adhesive: Maximum VOC content 80 g/L.
 - d. Fiberglass adhesive: Maximum VOC content 80 g/L.
 - e. Insulation joint sealant: Maximum VOC content 420 g/L.
 - f. Other: Maximum VOC content 420 g/L.
- E. Green Seal Standard GS-11
1. GS-11 – Paints and Coatings (flat insulation coatings); Edition 3.2, October 2015.
 - a. Vapor Barrier Coatings: Maximum VOC content 50 g/L.
 - b. Weather Barrier Mastics: Maximum VOC content 50 g/L.
 - c. Lagging Adhesive/Coating: Maximum VOC content 50 g/L.

1.03 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers published literature for each type of insulation. Data shall include product description, thermal characteristics, moisture absorption rating, flame spread and smoke developed ratings for each product.
- C. Submittal shall include a schedule indicating the following for each type of insulation:
1. Pipe or duct system
 2. Location (interior, exterior, mechanical room, etc.)
 3. Insulation and jacketing material
 4. Fitting insulation and jacketing material
 5. Pipe size range
 6. Insulation thickness

- D. Manufacturer's Installation Instructions: Submit manufacturer's published literature indicating proper installation procedures.

1.04 QUALITY ASSURANCE

- A. All equipment, duct and piping insulation used within the interior portions of the building on the project must have a flame spread rating not exceeding 25 and a smoke developed rating not exceeding 50, as determined by test procedures ASTM E 84 18 and UL 723. These ratings must be as tested on the composite of insulation, jacket or facing, and adhesive. Components such as adhesives, mastics and cements must meet the same individual ratings as the minimum requirements.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density, thermal ratings and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical and damage, by storing in original wrapping.
- D. All materials delivered to the site shall be dry, undamaged and maintained in good condition throughout the progress of the project.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature during and after installation for minimum period of 24 hours.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 ADHESIVES, MASTICS AND SEALANTS

- A. All adhesives, mastics, sealants and coatings utilized for pipe and duct insulation shall

have a maximum VOC content as specified in Part 1 of this Section.

2.02 PIPING - CELLULAR FOAM

- A. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - 1. 'K' Value: ASTM C177 or C518; 0.27 at 75°F.
 - 2. Service Temperature: -40°F. to 220°F.
 - 3. Water Absorption: ASTM D1056; 1.0% by volume.
 - 4. Water Vapor Permeability: ASTM E96; 0.20 perms-inches.
 - 5. Maximum Flame Spread: ASTM E84; 25.
 - 6. Maximum Smoke Developed: ASTM E84; 50.
 - 7. Connection: Waterproof vapor barrier adhesive.
 - 8. GEI Greenguard indoor air quality certified for low chemical and particle emission.
- B. Elastomeric Foam Adhesive
 - 1. Air dried, contact adhesive, compatible with insulation.
 - a. Foster 85-75.
 - b. Childers CP-82.
 - c. Armacell 520.

2.03 PIPING - JACKETS

- A. PVC Plastic
 - 1. Jacket: ASTM C921, one-piece molded type fitting covers and sheet material, off white color.
 - a. Service Temperature: -40°F. to 150°F.
 - b. Moisture Vapor Transmission: ASTM E96; 0.002 perms-inches.
 - c. Maximum Flame Spread: ASTM E84; 25.
 - d. Maximum Smoke Developed: ASTM E84; 50.
 - e. Thickness: 20 mil.
 - f. Connections: Brush on welding adhesive.
 - 2. Vapor Barrier Coating (Indoors) and Weather Barrier Breather Mastic:
 - a. Mold resistant, compatible with below ambient piping insulation with a white color finish. Permeability shall be a maximum of 0.08 perms or less at 37 mils dry tested at 100 degrees F (38 degrees C) and 90 percent RH per ASTM F1249. Coating shall meet ASTM D 5590 with 0 growth rating.
 - 1) Foster 30-80 AF.
 - b. Compatible with above ambient insulation: Weather barrier mastic-fire-

resistive mastic for indoor/outdoor use.

- 1) Foster 46-50.
- 2) Childers CP-10/CP-11

B. Aluminum Jacket: ASTM B209.

1. Thickness: 0.016 inch.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2 inch laps.
4. Fittings: 0.016 mm thick die-shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
6. Metal Jacketing/Flashing Sealant: Sealing of seams to prevent water entry.
 - a. Foster 95-44.
 - b. Childers CP-76.

2.04 INSULATION SHIELDS AND INSERTS

A. Insulation Shields:

1. Application: All insulated piping, except for below grade direct buried piping.
2. Shields shall be made of galvanized steel or made of black iron painted on both sides with a minimum two coats of aluminum paint. Minimum metal shield sizes shall be as listed within the following table. Provide thicker/longer shields where recommended by insulation manufacturer's published product installation data:

Nominal IPS (inches)	Minimum Metal Thickness (gage)	Minimum Length (inches)
1/2 to 1-1/4	18	12
1-1/2 to 2	16	12
2-1/2 to 8	14	18
10	12	24

3. Provide MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier.
4. Depending on the type of pipe support design, stainless steel bands or aluminum bands may be required to keep shield material next to the jacketing material.
 - a. Insulation Bands: 3/4 inch wide; 0.007-inch-thick galvanized steel when exposed to interior environment, 0.010-inch-thick stainless steel or 0.015-inch-thick aluminum when exposed to humid interior environment or outside environment.
 - b. Metal Jacket Bands: 3/8 inch wide; 0.015-inch-thick aluminum or 0.010-inch-thick stainless steel to match jacket.

B. Insulation Inserts:

1. Application: All insulated piping larger than 2-inch diameter, except for below grade direct buried piping.
2. Inserts for shields shall be manufactured of corrosion resistant insulating material; cellular glass, phenolic or polyisocyanurate, of minimum 5.0 lb/cu. ft. density, suitable for the planned temperature range.
3. Inserts shall be the same thickness and contour as the adjacent insulation and shall be at least as long as the metal shield.
4. Factory fabricated inserts with integral galvanized pipe shields will be acceptable.

2.05 DUCTWORK – GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible, blanket.
 1. “K” (KSI) value: ASTM C518, 0.27 at 75°F.
 2. Maximum service temperature: 250°F.
 3. Maximum moisture absorption: 0.20% by volume.
 4. Density: 1.0 lb/cu ft.
 5. GEI Greenguard indoor air quality certified for low chemical and particle emission.
- B. Vapor Barrier Jacket:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film.
 2. Water Vapor Permeability: ASTM E96; 0.04 1.3 perms-inch.
 3. Secure with pressure sensitive tape and coat all seams with vapor barrier coating.
- C. Vapor Barrier Tape:
 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive
- D. Vapor Barrier Coating:
 1. Mold resistant, water-based vapor barrier coating that is compatible with the insulation materials, jackets and substrates. White color finish. Permeability shall be a maximum of 0.08 perms or less at 37 mils dry tested at 100 degrees F and 90 percent RH per ASTM F1249. Coating shall meet ASTM D5590 with 0 growth rating.
 - a. Foster 30-80 AF.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify piping, equipment and ductwork has been tested before applying insulation materials.

- C. Verify surfaces are clean and dry, with foreign material removed.

3.02 COMMON INSULATION REQUIREMENTS

- A. Insulation shall not be installed until all testing and inspection of pipe, duct, vessel, etc. has been completed and approved by Engineer/Owner's representative.
- B. Replace insulation damaged by either moisture or other means. Insulation which has been wet, whether dried or not, is considered damaged. Make repairs where condensation is caused by improper installation of insulation. Also replace any materials damaged by the condensation.
- C. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- D. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- E. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- F. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- G. Install multiple layers of insulation with longitudinal and end seams staggered.
- H. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- I. Keep insulation materials dry during application and finishing.
- J. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- K. Install insulation with least number of joints practical.
- L. Install insulation continuously through hangers and sleeves and around anchor attachments.
- M. Where penetrating fire and/or smoke rated walls, partitions, barriers, or floors, provide UL-approved pipe and duct penetration assemblies that maintain the rating of the penetrated wall, partition, barrier, or floor.
- N. Insulation on all pipes or ducts conveying air or liquids below the ambient temperature is required to have a continuous vapor barrier. On all insulation with a vapor barrier, seal the joints, duct wrap seams, vapor retarder (ASJ) film seams and penetrations in insulation at hangers, supports, anchors, and other projections with a vapor-barrier coating/mastic as specified in the individual insulation sections.
 - 1. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier coating/mastic.

2. Install insert materials and install insulation to tightly join the insert. Seal insulation to inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 3. Cover inserts with jacket material matching adjacent pipe insulation.
 4. Install sheet metal shields over jacket at each hanger, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

3.03 PAINTING OF INSULATION

- A. Where indicated on the construction documents, paint duct or piping insulation in exposed areas, not including mechanical and equipment rooms. Do not paint insulation located in return air plenums.
- B. Prior to painting, wipe insulation jacket clean with a mild cleaning solution that will not leave a residue and allow to dry completely. Paint jacket with water based (latex) paint in accordance with manufacturer's recommendations and as required in the specification Section 09 90 00 Painting and Coating.

3.04 INSTALLATION – PIPE INSULATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Exposed Piping: Locate insulation and cover seams in least visible locations.
- C. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- D. Insulated pipes conveying fluids below ambient temperature:
1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch monel expanding staples and seal staple penetrations and all ASJ seams with vapor barrier coating.
 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier coating or PVC covers.
- E. For hot piping conveying fluids over 180 degrees F, insulate flanges and unions at equipment. If 180 degrees F or under, then bevel and seal ends of insulation with breather mastic.
- F. Insulated pipes conveying fluids above ambient temperature:
1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch monel expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 2. Insulate fittings, joints and valves with insulation of like material and thickness as

adjoining pipe. Finish with glass cloth and weather barrier breather mastic or PVC covers.

- G. Provide neck extensions or extended stems for valves installed in insulated lines. Refer to Section 23 21 13.
- H. Insulation Shields and Inserts:
 - 1. Application: Provide shields for all insulated piping, except for below grade direct buried piping. Provide insulation inserts for all piping or equipment larger than 2-inch diameter.
 - 2. Shields: Install between pipe hangers, pipe supports or pipe hanger rolls and inserts.
 - 3. Insert location: Install between support shield and piping and under finish jacket.
- I. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- J. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover all exterior pipe insulation with aluminum jacketing.
- K. PVC or aluminum jacket: Install with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom of piping or equipment.

3.05 INSTALLATION – EQUIPMENT INSULATION

- A. Install in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.
- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires or bands.
- E. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement. Coat with lagging cloth and lagging adhesive
- F. For all insulated equipment, insulate flanges and unions with removable sections and jackets.
- G. Finish insulation at supports, protrusions and interruptions.
- H. Nameplates and ASME Stamps conveying fluid above ambient temperature:
 - 1. Bevel and seal insulation around; do not insulate over.

- I. Nameplates and ASME Stamps conveying fluid below ambient temperature:
 - 1. Photograph ASME stamp, print, laminate and attach to vessel; insulate over.
- J. Equipment Requiring Access for Maintenance, Repair or Cleaning: Install insulation for easy removal and replacement without damage.
- K. Provide insulation over heating water reheat coils on terminal units.
- L. For internally lined ductwork or isolated equipment containing exposed u-bend coils; insulate over coil u-bends and around upper and lower equipment sides abutting coil, finish with 16 ga. brake metal to cover insulation. Sheet metal to match adjacent, exposed ductwork (paint grip or galvanized).

3.06 INSTALLATION – DUCT INSULATION

- A. Install in accordance with manufacturer's instructions.
- B. External Duct Insulation Application:
 - 1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder coating or tape to match jacket as specified in paragraphs below.
 - 2. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging.
 - 3. Where trapeze hangers are used, install the hanger first and insulate around the entire strut trapeze. Including the fastening point to the all-thread rod, the fastening nuts and the end of the all-thread rod below the fastening point. Refer to details on Drawings for additional information where applicable.
 - 4. Seal vapor retarder penetrations and all seams by mechanical fasteners with vapor barrier coating.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping. For any service access, bevel and seal ends of the insulation.
- C. Insulated ductwork conveying air below ambient temperature:
 - 1. Finish with tape and vapor retarder jacket. Finish all joints and seams with two coats of vapor barrier coating.
 - 2. Provide two coats of vapor barrier coating at the duct connection to air device insulation.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints. Insulation at flanges shall wrap entirely over flanges and trapeze supports (including bottom of hangers) and shall be the same thickness throughout. Crushing, cutting, or diminishing the thickness or performance of insulation at flanges in any way is not acceptable
 - 5. Insulate over filter frames and terminal unit reheat coils while maintaining full operation of access doors/panels without damaging insulation.

- D. Insulated ductwork conveying air above ambient temperature:
 - 1. Insulation installation shall be the same as for ductwork conveying air below ambient temperature but may be provided without standard vapor retarder jacket.

3.07 PIPING – INSULATION INSERTS AT SUPPORT POINTS

- A. Provide rigid insulation inserts at piping support points for piping systems larger than 2-inch diameter specified to have fiberglass pipe insulation.
- B. The inserts shall be equivalent in thickness to and compatible with the adjacent scheduled fiberglass insulation.
- C. For insulated pipes conveying fluids below ambient temperature, provide inserts of phenolic or polyisocyanurate material.
- D. For insulated pipes conveying fluids above ambient temperature, provide inserts of phenolic, polyisocyanurate or calcium silicate material.

3.08 PIPING – CELLULAR FOAM INSULATION SCHEDULE

PIPING SYSTEMS	PIPE SIZE INCH	MIN THICKNESS INCH	INSTALLED THICKNESS INCH
A. Condensate Drains	All	1/2"	
B. Refrigerant Suction Piping	All	1 1/2"	
C. Refrigerant Liquid Piping	All	1"	
D. Refrigerant Mixed Phase Piping	All	1 1/2"	
E. Field Applied Jackets:			
1. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor):			Finish with PVC jacket and fitting covers.
2. Pipe located outdoors:			Finish with aluminum jacket and fitting covers.

3.09 INDOOR DUCTWORK – GLASS FIBER FLEXIBLE INSULATION SCHEDULE

SYSTEM	MIN THICKNESS	MIN INSTALLED R-VALUE
A. Supply, Outside Air, Return	2"	6
B. Exhaust (connected to energy recovery equipment and within 5 feet of roof or exterior wall penetration)	2"	6

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- A. See Specification 01 9113 General Commissioning Requirements.

END OF SECTION

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SECTION 23 09 23 – DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes control equipment and software.

1.02 RELATED SECTIONS

- A. Section 23 08 00 - Commissioning of HVAC
- B. Section 23 34 00 - HVAC Fans
- C. Section 23 81 26 - Split-System Air Conditioners and Heat Pumps
- D. Section 23 81 27 – Variable Refrigerant Flow Outdoor Units
- E. Section 23 81 28 – Variable Refrigerant Flow Indoor Units
- F. Section 26 05 03 - Equipment Wiring Connections
- G. Section 26 05 29 - Hangers and Supports for Electrical Systems
- N. Section 26 05 33 - Raceway Systems
- O. Section 26 22 13 - Low-Voltage Transformers
- P. Section 26 24 19 - Motor Control Centers
- Q. Section 26 29 13 - Motor Controllers

1.03 REFERENCE STANDARDS

- A. The latest edition of the following standards and codes in effect and amended as of supplier's proposal date, and any applicable subsections thereof, shall govern design and selection of equipment and material supplied:
 - 1. ANSI/ASHRAE Standard 135-2001, BACnet.
 - 2. ANSI MC85.1 - Terminology for Automatic Control.
 - 3. UL 916 Underwriters Laboratories Standard for Energy Management Equipment.
 - 4. National Electrical Code (NEC).
 - 5. FCC Part 15, Subpart J, Class A
 - 6. UL-864 UUKL listing for Smoke Controls for any equipment used in smoke control sequences.

1.04 SYSTEM DESCRIPTION

- A. **The control system shall have capability for future intent of integrating into a fully connected multi-campus enterprise BAS (such as Schneider Electric EcoStructure). It shall consist of a high-speed, peer-to-peer network of DDC controllers. System shall be completely based on ANSI/ASHRAE Standard 135-2001, BACnet.**
- B. The system shall directly control HVAC equipment as specified in Contract Documents using native BACnet-compliant components. Each zone controller shall provide occupied and unoccupied modes of operation by individual zone. Furnish energy conservation features such as optimal start and stop, night setback, request-based logic, and demand level adjustment of setpoints as specified in the sequence.
- C. All communication wiring shall be shielded, stranded wire.
- D. Provide for future system expansion to include additional monitoring of occupant card access and future HVAC equipment.
- E. System shall use the BACnet protocol for communication to the operator workstation or web server and for communication between control modules. Non-BACnet-compliant or proprietary equipment or systems (including gateways) shall not be acceptable and are specifically prohibited. I/O points, schedules, setpoints, trends and alarms specified in Contract Documents shall be BACnet objects.

1.05 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Drawings
 - 1. The system supplier shall submit engineered Drawings, control sequence, and bill of materials for approval.
 - 2. Drawings shall be submitted in the following standard sizes: 11 inches x 17 inches (ANSI B).
 - 3. Eight complete sets (copies) of submittal drawings shall be provided.
 - 4. Drawings shall be available on CD-ROM in AutoCAD DXF or PDF format.
- C. System Documentation: Include the following in submittal package:
 - 1. System configuration diagrams in simplified block format.
 - 2. Direct Digital Control System Hardware
 - a. Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.
 - b. Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions for items listed below and for relevant items not listed below:

- 1) Direct digital controllers (controller panels)
 - 2) Transducers and transmitters
 - 3) Sensors (include accuracy data)
 - 4) Actuators
 - 5) Valves
 - 6) Relays and switches
 - 7) Control panels
 - 8) Power supplies
 - 9) Batteries
 - 10) Operator interface equipment
 - 11) Wiring
- c. Electrical Drawings that show all system internal and external connection points, terminal block layouts, and terminal identification.
 - d. Complete valve schedule and damper schedule.
 - e. Floor plan schematic diagrams indicating field sensor and controller locations.
 - f. Riser diagrams showing control network layout, communication protocol, and wire types.
3. Controlled Systems
- a. Riser diagrams showing control network layout, communication protocol, and wire types.
 - b. Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.
 - c. Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.
 - d. Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.
 - e. Complete description of control system operation including sequences of operation. Include and reference schematic diagram of controlled system. List I/O points and software points specified in the Contract Documents. Indicate alarmed and trended points.
4. Description of process, report formats and checklists as specified.
5. Manufacturer's instructions and Drawings for installation, maintenance and operation of all purchased items.
6. Overall system operation and maintenance instructions - including preventive maintenance and troubleshooting instructions.
7. For all system elements - operator's workstation(s), building controller(s), application controllers, routers, and repeaters - provide BACnet Protocol Implementation Conformance Statements (PICS) as per ANSI/ASHRAE Standard 135-2001.
8. Provide complete description and documentation of any proprietary (non-BACnet) services and/or objects used in the system.

9. A list of all functions available and a sample of function block programming that shall be part of delivered system.

1.06 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Submit four copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:
 1. Project Record Drawings: As-built versions of submittal Shop Drawings provided as AutoCAD DXF or PDF compatible files on optical disk and prints of each Drawing on 11-inch by 17-inch paper.
 2. Testing and Commissioning Reports and Checklists: Completed versions of reports, checklists and trend logs used to meet requirements as specified.
 3. Operation and Maintenance (O&M) Manual: Printed, electronic or online help documentation of the following:
 - a. As-built versions of submittal product data.
 - b. Names, addresses and telephone numbers of installing contractors and service representatives for equipment and control systems.
 - c. Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.
 - d. Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
 - e. Engineering, installation and maintenance manual or set of manuals that explains how to design and install new points, panels and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.
 - f. Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.
 - g. Graphic files, programs and database on optical media.
 - h. List of recommended spare parts with part numbers and suppliers.
 - i. Complete original-issue documentation, installation and maintenance information for furnished third-party hardware including computer equipment and sensors.
 - j. Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.
 - k. Licenses, guarantees and warranty documents for equipment and systems.
 - l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning and calibration; time between tasks; and task descriptions.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years of documented experience approved by manufacturer.
 - 1. The Building Automation System (BAS) system shall be designed, installed, commissioned and serviced by contractor authorized and trained personnel. System provider shall have an in-place support facility within 2 hours' response time of the site with technical staff, spare parts inventory, and necessary test and diagnostic equipment.

1.08 QUALITY ASSURANCE

- A. Materials and equipment shall be manufacturer's latest standard design that complies with the ANSI/ASHRAE Standard 13-2001, BACnet requirements.
- B. Performance Standards: System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
 - 1. Graphic Display: A graphic with 20 dynamic points shall display with current data within 10 seconds.
 - 2. Graphic Refresh: A graphic with 20 dynamic points shall update with current data within 8 seconds and shall automatically refresh every 15 seconds.
 - 3. Configuration and Tuning Screens: Screens used for configuring, calibrating or tuning points, PID loops, and similar control logic shall automatically refresh within 6 seconds.
 - 4. Object Command: Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
 - 5. Alarm Response Time: An object that goes into alarm shall be annunciated at the workstation within 15 seconds.
 - 6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.
 - 7. Performance: Programmable controllers shall be able to completely execute DOC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
 - 8. Multiple Alarm Annunciation: Each workstation on the network shall receive alarms within 5 seconds of other workstations.

9. Reporting Accuracy: System shall report values with minimum end-to-end accuracy listed in Table 1.
10. Control Stability and Accuracy: Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 1
Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)
Delta-T	+0.15°C (±0.25°F)
Relative Humidity	±5% RH
Water Flow	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1 % of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO ₂)	±50 ppm

Note 1: Accuracy applies to 10% - 100% of scale
 Note 2: For both absolute and differential pressure
 Note 3: Not including utility-supplied meters

Table 2
Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) +3 Pa (+0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5%RH	
Fluid Pressure	±10 kPa (±1.5 psi) +250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

1.09 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 – Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one-year manufacturer warranty for direct-digital controls effective from date of beneficial use as determined by Architect/Engineer and Owner.

1.12 MAINTENANCE SERVICE

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for maintenance service.
- B. Furnish service and maintenance of control systems for one year from Date of Substantial Completion.
- C. Furnish complete service of controls systems, including callbacks. Make minimum of four complete normal inspections of one in each season, in addition to normal service calls to inspect, calibrate and adjust controls. Submit written report after each inspection.
- D. Include systematic examination, adjustment and lubrication of unit, and controls checkout and adjustments. Repair or replace parts in accordance with manufacturer's operating and maintenance data. Use parts produced by manufacturer of original equipment ONLY.
- G. Perform work without removing units from service during building normal occupied hours.
- H. Provide emergency call back service at all hours for this maintenance period.

- I. Maintain locally, near Place of the Work, adequate stock of parts for replacement or emergency purposes. Have personnel available to ensure fulfillment of this maintenance service, without unreasonable loss of time.
- J. Perform maintenance work using competent and qualified personnel under supervision and in direct employ of manufacturer or original installer. Only verified, certified technicians of the equipment manufacturer shall perform the work.
- K. Do not assign or transfer maintenance service to agent or subcontractor without prior written consent of Owner.

1.13 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.01 DIRECT-DIGITAL CONTROLS

A. Approved Manufacturers:

- 1. Entech – Schneider Electric EcoStruxure
- 2. Automated Logic
- 3. JCI

2.02 POWER SUPPLIES AND LINE FILTERING

- A. Power Supplies: Control transformers shall be UL listed, Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements, Limit connected loads to 80 percent of rated capacity.
 - 1. DC power supply output shall match output current and voltage requirements, Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0 percent line and load combined, with 100-microsecond response time for 50 percent load changes, Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150 percent current overload for at least three seconds without trip-out or failure.
 - a. Unit shall operate between 0 degrees C and 50 degrees C (32 degrees F and 120 degrees F), EM/RF shall meet FCC Class Band VDE 0871 for Class Band MILSTD 810C for shock and vibration,
 - b. Line voltage units shall be UL recognized and CSA listed.
- B. Power Line Filtering
 - 1. Provide internal or external transient voltage and surge suppression for workstations and controllers, Surge protection shall have:
 - a. Dielectric strength of 1000 V minimum
 - b. Response time of 10 nanoseconds or less

- c. Transverse mode noise attenuation of 65 dB or greater
- d. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

2.03 BUILDING CONTROLLERS

A Standalone Digital Control Units (SDCUs)

1. General: Standalone Digital Control Units shall provide control of HVAC and lighting, including VRF system scheduling and monitoring, exhaust fans, dedicated outdoor air systems (DOAS), and other mechanical equipment. Each controller shall be fully programmable, contain its own control programs and will continue to operate in the event of a failure or communication loss to its associated NRC. Each SDCU provided must be a "native" BACnet device, supporting the BACnet Advanced Application Controller (B-AAC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. SDCUs shall be tested and certified by the BACnet Testing Laboratory (BTL) as Advanced Application Controllers (B-AAC).
2. Memory: Both the operating system of the controller, plus the application program for the controller, shall be stored in non-volatile, FLASH memory. Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20 percent additional free memory.
3. Communication Ports: SDCUs shall have a RS-485 communication port to the BACnet MS/TP field bus, operating at a speed of at least 19.2kbps.
4. Input/Output: Each SDCU shall have enough inputs and outputs to meet the application's required point count. Each SDCU shall support universal inputs, whereas any input may be software-defined as:
 - a. Digital Inputs for status/alarm contacts
 - b. Counter Inputs for summing pulses from meters.
 - c. Thermistor Inputs for measuring temperatures in space, ducts and thermowells.
 - d. Analog inputs for pressure, humidity, flow and position measurements.
5. SDCUs must support both digital and analog output types:
 - a. Digital Outputs for on/off equipment control.
 - b. Analog Outputs for valve and damper position control, and capacity control of primary equipment.
6. Expandability: For larger controllers (16 base inputs and up), provide input and output expansion through the use of plug-in modules. At least two I/O modules must be capable of being added to the base SDCU.
7. Hardware Override Switches: All digital outputs on air handling unit controllers shall include three position manual override switches to allow selection of the ON, OFF or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output on air handling unit controllers shall be equipped with an override potentiometer to allow manual

adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

8. Room Sensor Support: The SDCU shall support a basic room thermistor in plain plastic cover; a room sensor with override and setpoint adjust slider; and, a sensor with a one-line display and 6-button keypad. The display sensor shall be able to display the current temperature, setpoint, outside air temperature, relative humidity and setpoint, occupancy mode, and CFM of the individual zone.
9. Networking: Each SDCU will be able to exchange information on a peer to peer basis with other Standalone Digital Control Units, according to the BACnet MS/TP protocol. Each SDCU shall be capable of storing and referencing global variables (on the LAN) with or without any workstations online. Each SDCU shall be able to have its program viewed and/or enabled/disabled through a workstation connected to an NRC.
10. Indicator Lamps: SDCUs will have as a minimum, LED indication of CPU status, and field bus status.
11. Real Time Clock (RTC): All SDCUs shall have a real time clock in either hardware or software. The accuracy shall be within 10 seconds per day. The RTC shall provide the following information: time of day, day, month, year, and day of week. Each SDCU shall receive a signal, every hour, over the network from the NRC, which synchronizes all SDCU real time clocks.
12. Automatic Restart After Power Failure: Upon restoration of power, the SDCU shall automatically and without human intervention, update all monitored functions, resume operation based on current, synchronized time and status, and implement special start-up strategies as required.
13. Battery Backup: All SDCUs shall store all programming in non-volatile FLASH memory. All SDCUs except terminal controllers shall include an on-board lithium battery to back up the controller's RAM memory. The battery shall have a shelf life of over 10 years, and provide accumulated backup of all RAM and clock functions for at least 3 years. In the case of a power failure, the SDCU shall first try to restart from the RAM memory. If that memory is corrupted or unusable, then the SDCU shall restart itself from its application program stored in its FLASH memory.
14. Software – General: The SDCU shall contain FLASH memory to store both the resident operating system AND the application software. There will be no restrictions placed on the type of application programs in the system. Each SDCU shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.
15. User Programming Language: The application software shall be user programmable, using the same language as that defined for Network Router/Controllers. Controllers that use a "canned" program method will not be accepted.

16. Control Software, Mathematical Functions, and Energy Management Applications must be identical to that which is provided with the Network Router/Controller.
17. History Logging: Each controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable over user defined time intervals ranging from 1 second to 1440 minutes. Any system can be logged in history. A minimum of 1000 values shall be stored in each log. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to the Operator Workstation for long term archiving based upon user-defined time intervals, or manual command.
18. Alarm Management: For each system point, alarms can be created based on high/low limits or conditional expressions. All alarms will be tested each scan of the SDCU and can result in the display of one or more alarm messages or reports.
 - a. Up to 8 alarms can be configured for each point in the controller.
 - b. Alarms will be generated based on their priority. A minimum of 255 priority levels shall be provided.
 - c. If communication with the Operator Workstation is temporarily interrupted, the alarm will be time-stamped and buffered in the controller. When communications return, the alarm will be transmitted to the Operator Workstation if the point is still in the alarm condition.
 - d. Alarms must be capable of being routed to any BACnet workstation that conforms to the B-OWS device profile and uses the BACnet/IP protocol.

2.05 APPLICATION SPECIFIC CONTROLLERS (HEAT PUMPS, AC UNITS, FAN-COILS)

A. Unitary Controllers

1. Unitary controllers shall conform to the BACnet Advanced Application Controller (B-AAC) device profile.
2. Unitary controllers shall support, but not be limited to, the control of the following systems as described in the Execution portion of this specification, and for future expansion:
 - a. DX Rooftop Dedicated Outdoor Air Systems (DOAS)
3. The I/O of each Unitary Controller shall contain the sufficient quantity and types as required to meet the sequence of operation found in the Execution portion of this specification. In addition, each controller shall have the capability for local time of day scheduling, occupancy mode control, after hour operation, lighting control, alarming, and trending.
4. Unitary Controllers shall be able to communicate with any other Standalone Digital Control Unit on the same MS/TP field bus.

2.07 AUXILIARY CONTROL DEVICES

A. Temperature Sensors

1. Type: Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor. All temperature sensors to be solid-state electronic, interchangeable with housing appropriate for application.
 2. Duct Sensors: Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of 1.5 meters (5 feet) in length per 1 m² (10 ft²) of duct cross-section. Duct sensors to be installed such that the sensing element is in the main air stream.
 3. Immersion Sensors: Provide immersion sensors with a separable stainless steel well. Well pressure rating shall be consistent with system pressure it will be immersed in. Well shall withstand pipe design flow velocities. Immersion sensors to be installed in wells provided by control contractor, but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors.
 4. Space Sensors: Space sensors shall have setpoint adjustment, override switch, display and communication port as shown. Wall sensors to be installed as indicated on Drawings. Mount 48 inches above finished floor.
 5. Differential Sensors: Provide matched sensors for differential temperature measurement.
- B. Outside Air Sensors: Shall be installed away from exhaust or relief vents, not in an outside air intake. Sensor shall be provided with a solar radiation shield.
- C. Humidity Sensors (where shown in the Drawings)
1. Duct and room sensors shall have a sensing range of 20-80 percent.
 2. Duct sensors shall have a sampling chamber.
 3. Outdoor air humidity sensors shall have a sensing range of 20-95 percent RH and shall be suitable for ambient conditions of 40 degrees C-75 degrees C (40 degrees F-170 degrees F).
 4. Humidity sensors shall not drift more than 1 percent of full scale annually.
- D. CO2 Sensors (where shown in the Drawings)
1. Carbon Dioxide sensors shall measure CO2 in PPM in a range of 0-2000 ppm. Accuracy shall be +/- 3% of reading with stability within 5% over 5 years. Sensors shall be duct or space mounted as indicated in the sequence of operation.
- E. Binary Temperature Devices
1. Low-Voltage Space Thermostats: Low-voltage space thermostats shall be 24 V, bimetal-operated, mercury-switch type, with adjustable or fixed anticipation heater, concealed setpoint adjustment, 13 degrees C-30 degrees C (55 degrees F-85 degrees F) setpoint range, 1 degree C (2 degrees F) maximum differential, and vented ABS plastic cover.

2. Low-Limit Thermostats: Low-limit airstream thermostats shall be UL listed, vapor pressure type. Element shall be at least 6 meters (20 feet) long. Element shall sense temperature in each 30 cm (1 foot) section and shall respond to lowest sensed temperature. Low-limit thermostat shall be manual reset only.

F. Relays

1. Control Relays: Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.
2. Time Delay Relays: Time delay relays shall be solid-state plug-in type, UL listed, and shall have adjustable time delay. Delay shall be adjustable ± 100 percent from setpoint shown. Contact rating, configuration, and coil voltage shall be suitable for application. Provide NEMA 1 enclosure for relays not installed in local control panel.

G. Current Transmitters

1. AC current transmitters shall be self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output. Full-scale unit ranges shall be 10 A, 20 A, 50 A, 100 A, 150 A and 200 A, with internal zero and span adjustment. Unit accuracy shall be ± 1 percent full-scale at 500 ohm maximum burden.
2. Transmitter shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized.
3. Unit shall be split-core type for clamp-on installation on existing wiring.

H. Current Transformers

1. AC current transformers shall be UL/CSA recognized and shall be completely encased (except for terminals) in approved plastic material.
2. Transformers shall be available in various current ratios and shall be selected for ± 1 percent accuracy at 5 A full-scale output.
3. Use fixed-core transformers for new wiring installation and split-core transformers for existing wiring installation.

I. Voltage Transmitters

1. AC voltage transmitters shall be self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
2. Adjustable full-scale unit ranges shall be 100-130 Vac, 200-250 Vac, 250-330 Vac and 400-600 Vac. Unit accuracy shall be ± 1 percent full-scale at 500 ohm maximum burden.
3. Transmitters shall meet or exceed ANSI/ISA S50.1 requirements and shall be UL/CSA recognized at 600 Vac rating.

J. Voltage Transformers

1. AC voltage transformers shall be UL/CSA recognized, 600 Vac rated, and shall have built-in fuse protection.
2. Transformers shall be suitable for ambient temperatures of 4 degrees C-55 degrees C (40 degrees F-130 degrees F) and shall provide ± 0.5 percent accuracy at 24 Vac and 5 VA load.
3. Windings (except for terminals) shall be completely enclosed with metal or plastic.

K. Current Switches

1. Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

L. Local Control Panels

1. Indoor control panels shall be fully enclosed NEMA 1 construction with hinged door key-lock latch and removable sub-panels. A common key shall open each control panel and sub-panel.
2. Prewire internal and face-mounted device connections with color-coded stranded conductors tie-wrapped or neatly installed in plastic troughs. Field connection terminals shall be UL listed for 600V service, individually identified per control and interlock drawings, with adequate clearance for field wiring.
3. Each local panel shall have a control power source power switch (on-off) with overcurrent protection.
4. Provide with battery-powered Uninterruptible Power Supply.
5. Provide with 120V convenience outlet.

M. Field Service Tool

1. Field service tool shall allow technician to view and modify all setpoints and tuning parameters stored in application controller. In addition, technician shall be able to view status of all inputs and outputs on digital readout. Each piece of data shall have a data code associated with it that is customizable.
2. Field service tool shall plug into wall sensor and provide all the specified functionality.
3. Provide 2 Field Service Tools for this project.
4. All field service tools shall be given to the Owner's representative.

N. Network Connection Tool

1. Network connection tool shall allow technician to connect a laptop to any MS/TP network or at any MS/TP device and view and modify all information throughout the entire BACnet network. Laptop connection to tool shall be through Ethernet or PTP.
2. Provide quick connect to MS/TP LAN at each controller. Tool shall be able to adjust to all MS/TP baud rates specified in the BACnet standard.
3. Provide 2 Network Connection Tools for this project.
4. All field service tools shall be given to the Owner's representative.

O. Water/Gas Meters

1. Refer to controls Drawings for meters to be furnished and installed by controls contractor.

2.08 ELECTRONIC ACTUATORS AND VALVES

A. Quality Assurance for Actuators and Valves

1. UL Listed Standard 873 and CSA Class 4813 02 certified.
2. NEMA 2 rated enclosures for inside mounting; provide with weather shield for outside mounting.
3. Five-year manufacturer's warranty: Two-year unconditional and three-year product defect from date of installation.

B. Execution Details for Actuators and Valves

1. Furnish a freeze-stat and install "hard wire" interlock to disconnect the mechanical spring return actuator power circuit for fail-safe operation. Use of the control signal to drive the actuators closed is not acceptable.
2. Each DDC analog output point shall have an actuator feedback signal, independent of control signal, wired and terminated in the control panel for true position information and troubleshooting. Or the actuator feedback signal may be wired to the DDC as an analog input for true actuator position status.
3. Booster-heat valve actuation shall be floating type or analog (2-10vdc, 4-20ma).
4. Primary valve control shall be analog (2-10VDC, 4-20mA).

C. Actuators for damper and control valves 0.5-6 inches shall be electric unless otherwise specified, provide actuators as follows:

1. UL Listed Standard 873 and Canadian Standards association Class 481302 shall certify actuators.
2. NEMA 2 rated actuator enclosures for inside mounting. Use additional weather shield to protect actuator when mounted outside.

3. Five-year manufacturer's warranty: Two-year unconditional and three-year product defect from date of installation.
4. Mechanical spring shall be provided when specified. Capacitors or other non-mechanical forms of fail-safe are not acceptable.
5. Position indicator device shall be installed and made visible to the exposed side of the actuator. For damper short shaft mounting, a separate indicator shall be provided to the exposed side of the actuator.
6. Overload Protection: Actuators shall provide protection against actuator burnout by using an internal current limiting circuit or digital motor rotation sensing circuit. Circuit shall insure that actuators cannot burn out due to stalled damper or mechanical and electrical paralleling. End switches to deactivate the actuator at the end of rotation are acceptable only for butterfly valve actuators.
7. A pushbutton gearbox release shall be provided for all non-spring actuators.
8. Modulating actuators shall be 24VAC and consume 1 OVA power or less.
9. Conduit connectors are required when specified and when code requires it.

D. Damper Actuators:

1. Outside air and exhaust air damper actuators shall be mechanical spring return. Capacitors or other non-mechanical forms of fail-safe are not acceptable. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the damper as required.
2. Economizer actuators shall utilize analog control 2-10VDC, floating control is not acceptable.
3. Electric damper actuators shall be direct shaft-mounted and use a V-bolt and toothed V-clamp causing a cold weld effect for positive gripping. Single bolt or set-screw type fasteners are not acceptable.
4. One electronic actuator shall be direct shaft-mounted per damper section. No connecting rods or jackshafts shall be needed. Small outside air and return air economizer dampers may be mechanically linked together if one actuator has sufficient torque to drive both and damper drive shafts are both horizontal installed.
5. Multi-section dampers with electric actuators shall be arranged so that each damper section operates individually. One electronic actuator shall be direct shaft-mounted per damper section. (See below execution section for more installation details.)

E. Control Dampers

1. The BAS contractor shall furnish and size all automatic control dampers unless provided with packaged equipment. The sheet metal contractor shall install all dampers unless provided with packaged equipment. If control dampers require

120V power or higher voltage, Contractor shall coordinate with Division 26 for installation of power.

2. All dampers used for modulating service shall be opposed blade type and arranged for normally open or normally closed operation as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop for effective throttling.
3. All dampers used for two-position or open-close control shall be parallel blade type arranged for normally open or closed operation as required.
4. Damper linkage hardware shall be constructed of aluminum or corrosion-resistant zinc and nickel-plated steel and furnished as follows:
5. Bearing support bracket and drive blade pin extension shall be provided for each damper section. Sheet metal contractor shall install bearing support bracket and drive blade pin extension. Sheet metal contractor shall provide permanent indication of blade position by scratching or marking the visible end of the drive blade pin extension.
6. Drive pin may be round only if V-bolt and toothed V-clamp is used to cause a cold weld effect for positive gripping. For single bolt or set-screw type actuator fasteners, round damper pin shafts must be milled with at least one side flat to avoid slippage.
7. Damper manufacturer shall supply alignment plates for all multi-section dampers.

2.09 ENCLOSURES

- A. All controllers, power supplies and relays shall be mounted in enclosures.
- B. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures shall be NEMA 12 when installed in other than a clean environment.
- C. Enclosures shall have hinged, locking doors.
- D. Provide laminated plastic nameplates for all enclosures in any mechanical room or electrical room. Include location and unit served on nameplate. Laminated plastic shall be 0.125 inches thick and appropriately sized to make label easy to read.

2.10 WIRING AND RACEWAYS

- A. General. Provide copper wiring, plenum cable, and raceways as specified in applicable sections of Division 26.
- B. Insulated wire shall use copper conductors and shall be UL listed for 90°C (200°F) minimum service.
- C. All wiring installed as part of the VRF system controls shall be shielded and stranded type wiring.

2.11 FIBER-OPTIC CABLE SYSTEM

- A. Optical Cable: Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125 mm.
- B. Connectors: Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- C. Notify the Owner's representative in writing of conditions detrimental to the proper and timely completion of the work.
- D. Do not begin work until all unsatisfactory conditions are resolved.

3.02 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Manufacturer's field services.

3.03 PROTECTION

- A. Controls contractor shall protect against and be liable for damage to work and to material caused by Contractor's work or employees.
- B. Controls Contractor shall be responsible for work and equipment until inspected, tested and accepted. Protect material not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign objects.

3.04 COORDINATION

- A. Site
 - 1. Assist in coordinating space conditions to accommodate the work of each trade where work will be installed near or will interfere with work of other trades. If installation without coordination causes interference with work of other trades, Contractor shall correct conditions without extra charge.
 - 2. Coordinate and schedule work with other work in the same area and with work dependent upon other work to facilitate mutual progress.
- B. Submittals: See Submittals article in this section.
- C. Test and Balance

1. Provide test and balance contractor a single set of necessary tools to interface to control system for testing and balancing.
2. Train test and balance contractor to use control system interface tools.
3. Provide a qualified technician to assist with testing and balancing the first 20 terminal units.
4. Test and balance contractor shall return tools undamaged and in working condition at completion of testing and balancing.

D. Life Safety

1. Duct smoke detectors required for air handler shutdown are provided under Division 28. Interlock smoke detectors to air handlers for shutdown as specified in Contract Documents.

E. Coordination with Other Controls: Integrate with and coordinate controls and control devices furnished or installed by others as follows.

1. Communication media and equipment shall be provided as specified.
2. Each supplier of a controls product shall configure, program, start up and test that product to meet the sequences of operation described in the Contract Documents regardless of where within the Contract Documents those products are described.
3. Coordinate and resolve incompatibility issues that arise between control products provided under this section and those provided under other sections or divisions of this specification.
4. Controls Contractor shall be responsible for integration of control products provided by multiple suppliers regardless of where integration is described within the Contract Documents.

3.05 GENERAL WORKMANSHIP

- A. Install equipment, piping and wiring or raceway horizontally, vertically and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation and wiring shall comply with industry specifications and standards and local codes for performance, reliability and compatibility.

3.06 FIELD QUALITY CONTROL

- A. Work, materials and equipment shall comply with rules and regulations of applicable local, state and federal codes and ordinances as identified in Section 23 09 23 Article 1.8 (Codes and Standards).
- B. Continually monitor field installation for code compliance and workmanship quality.
- C. Contractor shall arrange for work inspection by local or state authorities having jurisdiction over the work.

3.07 WIRING

- A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of Section 23 09 23 differ from Division 26, Section 23 09 23 shall take precedence.
- B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC and Division 26.
- C. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
- D. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- E. Install wiring in raceway where subject to mechanical damage and at levels below 3 meters (10 feet) in mechanical, electrical, or service rooms.
- F. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- G. Do not install wiring in raceway containing tubing.
- H. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 3 meters (10 feet) intervals.
- I. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- J. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- K. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- L. Include one pull string in each raceway 2.5 cm (1 inch) or larger.
- M. Use color-coded conductors throughout.

- N. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- O. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 15 cm (6 inches) between raceway and high-temperature equipment.
- P. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- Q. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- R. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- S. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 meter (3 feet) in length and shall be supported at each end. Do not use flexible metal raceway less than 1/2 inch electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
- T. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.08 COMMUNICATION WIRING

- A. Communication wiring shall be shielded and stranded low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available. Runs longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."
- I. BACnet MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:

1. The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)
2. The maximum length of an MS/TP segment is 1200 meters (4000 feet) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485.
3. The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.
4. An MS/TP EIA-485 network shall have no T connections.

3.09 FIBER-OPTIC CABLE

- A. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- B. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

3.10 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.
- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 3 meters (1 foot) of sensing element for each 1 m² (1 ft²) of coil area.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure

1. Supply Duct Static Pressure: Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 2. Return Duct Static Pressure: Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 3. Building Static Pressure: Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DOC software to monitor safety switch status.

3.11 ACTUATORS

- A. General: Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators: Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation. Link actuators according to manufacturer's recommendations.
1. For low-leakage dampers with seals, mount actuator with a minimum 5' travel available for damper seal tightening.
 2. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5' open position, manually close the damper, then tighten linkage.
 3. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 4. Provide necessary mounting hardware and linkages for actuator installation.
- C. Valve Actuators: Connect actuators to valves with adapters approved by actuator manufacturer.

3.12 WARNING LABELS

- A. Affix permanent warning labels to equipment that can be automatically started by the control system.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows:

CAUTION

This equipment is operating under automatic control and may start or stop at any time without warning. Switch disconnect to "Off" position before servicing.

- B. Affix permanent warning labels to motor starters and control panels that are connected to multiple power sources utilizing separate disconnects.
 - 1. Labels shall use white lettering (12-point type or larger) on a red background.
 - 2. Warning labels shall read as follows:

CAUTION

This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

3.13 IDENTIFICATION OF HARDWARE AND WIRING

- A. Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 5 cm (2 inches) of termination.
- B. Label pneumatic tubing at each end within 5 cm (2 inches) of termination with a descriptive identifier.
- C. Permanently label or code each point of field terminal strips to show instrument or item served.
- D. Label control panels with minimum 1 cm (1/2 inch) letters on laminated plastic nameplates.
- E. Label each control component with a permanent label. Label plug-in components such that label remains stationary during component replacement.
- F. Label room sensors related to terminal boxes or valves with nameplates.
- G. Manufacturers' nameplates and UL or CSA labels shall be visible and legible after equipment is installed.
- H. Label identifiers shall match record documents.

3.14 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Startup Testing: Complete startup testing to verify operational control system before notifying Owner of system demonstration. Provide Owner with schedule for startup testing. Owner may have representative present during any or all startup testing.
1. Calibrate and prepare for service each instrument, control and accessory equipment furnished under Section 23 09 23.
 2. Verify that control wiring is properly connected and free of shorts and ground faults. Verify that terminations are tight.
 3. Enable control systems and verify each input device's calibration. Calibrate each device according to manufacturer's recommendations.
 4. Verify that binary output devices such as relays, solenoid valves, two-position actuators and control valves, and magnetic starters, operate properly and that normal positions are correct.
 5. Verify that analog output devices such as I/Ps and actuators are functional, that start and span are correct, and that direction and normal positions are correct. Check control valves and automatic dampers to ensure proper action and closure. Make necessary adjustments to valve stem and damper blade travel.
 6. Prepare a log documenting startup testing of each input and output device, with technician's initials certifying each device has been tested and calibrated.
 7. Verify that system operates according to sequences of operation. Simulate and observe each operational mode by overriding and varying inputs and schedules. Tune PID loops and each control routine that requires tuning.
 8. Alarms and Interlocks
 - a. Check each alarm with an appropriate signal at a value that will trip the alarm.
 - b. Trip interlocks using field contacts to check logic and to ensure that actuators fail in the proper direction.
 - c. Test interlock actions by simulating alarm conditions to check initiating value of variable and interlock action.

3.15 CONTROL SYSTEM DEMONSTRATION AND ACCEPTANCE

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstration: Prior to acceptance, perform the following performance tests to demonstrate system operation and compliance with specification after and in addition to tests as specified. Provide Engineer with log documenting completion of startup tests.
1. Engineer will be present to observe and review system demonstration. Notify Engineer at least 10 days before system demonstration begins.
 2. Demonstration shall follow the submitted and approved process. Complete approved checklists and forms for each system as part of system demonstration.

3. Demonstrate actual field operation of each sequence of operation as specified in Contract Documents. Provide at least two persons equipped with two-way communication. Demonstrate calibration and response of any input and output points requested by Engineer. Provide and operate test equipment required to prove proper system operation.
4. Demonstrate compliance with Performance Standards as specified in this section.
5. Demonstrate compliance with sequences of operation through each operational mode.
6. Demonstrate complete operation of operator interface.
7. Demonstrate each of the following:
 - a. DDC loop response: Supply graphical trend data output showing each DDC loop's response to a setpoint change representing an actuator position change of at least 25 percent of full range. Trend sampling rate shall be from 10 seconds to 3 minutes, depending on loop speed. Each sample's trend data shall show set point, actuator position, and controlled variable values. Engineer will require further tuning of each loop that displays unreasonably under- or over-damped control.
 - b. Demand limiting: Supply trend data output showing demand-limiting algorithm action. Trend data shall document action sampled each minute over at least a 30-minute period and shall show building kW, demand-limiting setpoint, and status of setpoints and other affected equipment parameters.
 - c. Trend logs for each system: Trend data shall indicate setpoints, operating points, valve positions, and other data as specified in the points list provided with each sequence of operation in the Contract Documents. Each log shall cover three 48-hour periods and shall have a sample frequency not less than 10 minutes or as specified on its points list. Logs shall be accessible through system's operator interface and shall be retrievable for use in other software programs as specified.
8. Tests that fail to demonstrate proper system operation shall be repeated after Contractor makes necessary repairs or revisions to hardware or software to successfully complete each test.

B. Acceptance

1. After tests described in this specification are performed to the satisfaction of both Engineer and Owner, Engineer will accept control system as meeting completion requirements. Engineer may exempt tests from completion requirements that cannot be performed due to circumstances beyond Contractor's control. Engineer will provide written statement of each exempted test. Exempted tests shall be performed as part of warranty.
2. System shall not be accepted until completed demonstration forms and checklists are submitted and approved as required this section.

3.16 CLEANING

- A. Each day clean up debris resulting from work. Remove packaging material as soon as its contents have been removed. Collect waste and place in designated location.
- B. On completion of work in each area, clean work debris and equipment. Keep areas free from dust, dirt and debris.
- C. On completion of work, check equipment furnished under this section for paint damage. Repair damaged factory-finished paint to match adjacent areas. Replace deformed cabinets and enclosures with new material and repaint to match adjacent areas.

3.17 TRAINING

- A. Provide training for a designated staff of Owner's representatives. Training shall be provided via self-paced training, web-based or computer-based training, classroom training or a combination of training methods.
- B. Training shall enable students to accomplish the following objectives:
 - 1. Proficiently operate system.
 - 2. Understand control system architecture and configuration.
 - 3. Understand DDC system components.
 - 4. Understand system operation, including DDC system control and optimizing routines (algorithms).
 - 5. Operate peripherals.
 - 6. Adjust and change system setpoints, time schedules, and holiday schedules
 - 7. Recognize common HVAC system malfunctions by observing system graphics, trend graphs, and other system tools
 - 8. Understand system drawings and Operation and Maintenance manual.
 - 9. Understand job layout and location of control components.
 - 10. Access data from DDC controllers.
 - 11. Operate portable operators' terminals.
 - 12. Create, delete and modify alarms, including configuring alarm reactions.
 - 13. Add, remove and modify system's physical points.
 - 14. Create, modify and delete application programming.
 - 15. Add a new controller to system.
 - 16. Download firmware and advanced applications programming to a controller.

17. Configure and calibrate I/O points.
- C. Divide presentation of objectives into three sessions [(1-6 (2 hours), 7-14 (3 hours) and 15-17 (3 hours))]. Participants will attend one or more of sessions, depending on knowledge level required.
 1. Day-to-day Operators (objectives 1-6).
 2. Advanced Operators (objectives 1-14).
 3. System Managers and Administrators (objectives 1-17).
 - D. Provide course outline and materials according to the Submittals article in this section. Provide one copy of training material per student.
 - E. Instructors shall be factory-trained and certified and experienced in presenting this material.
 - F. Perform classroom training using a network of working controllers representative of installed hardware.

END OF SECTION

SECTION 23 21 13 – CONDENSATE PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Condensate drains, equipment drains and overflows.

B. Related Sections:

1. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports, sleeves for placement by this section.
2. Section 23 07 00 – HVAC Insulation: Product requirements for Piping Insulation for placement by this section.

1.02 REFERENCES

A. ASTM International:

1. ASTM B88 – Standard Specification for Seamless Copper Water Tube.
2. ASTM F708 – Standard Practice for Design and Installation of Rigid Pipe Hangers.
3. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

B. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 – Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 – Pipe Hangers and Supports - Selection and Application.

1.03 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections whenever jointing dissimilar metals.
- B. Provide flanges, union, and/or couplings at locations requiring servicing. Use unions and/or couplings at equipment or apparatus connections.
- C. Provide pipe hangers and supports in accordance with Section 23 05 29, unless indicated otherwise.

1.04 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

- B. Shop Drawings: Indicate schematic layout of each piping system, including equipment, critical dimensions, and sizes.
- C. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
 - 2. Hangers and Supports: Submit manufacturers catalog information including load capacity.
- D. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures and isolation.
- E. Test Reports: Indicate results of each piping system pressure test.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of piping, equipment and accessories on as-built drawings during construction and transfer information to Record Document as directed in Section 01 70 00.
- C. Operation and Maintenance Data: Submit instructions for installation and changing components, spare parts lists, exploded assembly views.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with applicable Mechanical Code including any local amendments.
- B. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- C. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.
- D. Piping: All piping installed on this project shall bear the complete ASTM and manufacturer marking, labeling and identification requirements as required by ASTM. All installed piping 3'-0" or greater in length shall be readily identifiable per ASTM labeling criteria. Piping not bearing this identification upon installation shall be removed and replaced by the correctly labeled piping. Piping shall not be re-stenciled after it is installed to meet these criteria. Maintain one copy of each document on site.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
- B. Protect stored piping, fittings from entry of foreign materials. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation. If stored outdoors, elevate materials above grade.
- C. Protect installed piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 – Product Requirements.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Requirements for coordination.

PART 2 PRODUCTS

2.01 CONDENSATE DRAINS, EQUIPMENT DRAINS AND OVERFLOWS

- A. PVC Pipe: ASTM D1785, Schedule 40, polyvinyl chloride (PVC) material, bell and spigot style solvent sealed joints.
 - 1. Fittings: PVC, ASTM D2665, Schedule 40.
 - 2. Joints: ASTM D2855; solvent weld with ASTM D2564 solvent cement.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

- A. Remove scale and dirt on inside and outside before assembly.
- B. Prepare piping connections to equipment with flanges or unions.
- C. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 INSTALLATION – PIPE HANGERS AND SUPPORTS

- A. Install pipe hangers and supports in accordance with Section 23 05 29.

3.04 INSTALLATION – ABOVE GROUND PIPING SYSTEMS

- A. Install piping in accordance with applicable Mechanical Code including any local amendments, and ASME B31.9.
- B. Install in accordance with manufacturer's instructions.
- C. Route piping parallel to building structure, unless shown otherwise on drawings, and to maintain gradient.
- D. Space piping, including insulation, to provide one inch minimum clearance from adjacent piping or other surfaces. Increase pipe spacing as needed to account for grooved couplings and/or flanged fittings.
- E. Install piping to conserve building space, and not interfere with use of space.
- F. Group piping whenever practical at common elevations.
- G. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 07 84 00.
- H. Provide access where fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- J. Insulate and jacket piping as per Section 23 07 00.
- K. Install a cleanout tee with threaded plug at changes of direction in condensate drain piping.

3.05 PLASTIC PIPE AND JOINT FABRICATION

- A. Cut plastic pipe with pipe cutters using a cutting wheel specifically designed for plastic pipe.
- B. Remove all burrs, chips, filings, etc. from both the I.D. and O.D. of the pipe before joining. Use a knife, deburring tool, or a half-pound coarse file to remove all burrs.
- C. Bevel all pipe ends to minimize the chances of wiping the solvent cement from the I.D. of the fitting as the pipe is socketed. Use a beveling tool designed to bevel pipe at a 10° to 15° angle and a depth of 1/16" to 3/32".
- D. Using a clean, dry, cotton rag, wipe away all loose dirt and moisture from the I.D. and O.D. of the pipe end and the I.D. of the fitting. Do not solvent weld wet surfaces.
- E. Apply primer to the pipe surface in the same manner, making sure that the length of pipe evenly brushed is at least equal to the fitting socket depth.

- F. For checking penetration, scratch or scrape away the primed surface until a few thousandths of an inch can be so removed. Repeat applications of primer to either or both surfaces as necessary. In cold weather, allow more time for proper penetration.
- G. Cover the outer pipe surface literally with solvent cement for a length at least equal to that of the fitting socket depth.
- H. Continue alternate application to the fitting socket with a medium layer of solvent cement. Avoid puddling in the socket. On belled end pipe, do not coat beyond the socket depth or allow cement to run beyond the bell.
- I. Apply a second coat of cement to the pipe. Cement layers must be without voids and sufficient to fill any gaps in the joints.
- J. Immediately upon finishing cement application and before it starts to set, insert the pipe to the full socket depth while rotating the pipe or fitting 1/4 turn to ensure complete and even distribution of the cement. Hold joint together for a minimum of 10 to 15 seconds to make sure that pipe does not move back out of the socket.
- K. Immediately after joining and before joint is set, gently place joint onto a level surface, and wipe off all excess cement from the circumference of the joint.
- L. Do not perform joining operations if ambient temperature is below 40 F. Allow a minimum of 72 hours of joint drying time before subjecting joints to any appreciable internal pressure.

3.06 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements, 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

SECTION 23 23 00 – REFRIGERANT PIPING (10 TONS AND SMALLER)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Refrigerant piping.
2. Unions, flanges and couplings.
3. Pipe hangers and supports.
4. Refrigerant moisture and liquid indicators.
5. Valves.
6. Refrigerant filter-driers.
7. Expansion valves.

B. Related Sections:

1. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
2. Section 08 31 13 - Access Doors and Frames: Access doors for concealed valves and accessories.
3. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for pipe identification for placement by this section.
4. Section 23 07 00 - HVAC Insulation: Product requirements for Piping Insulation for placement by this section.

1.02 REFERENCES

A. Air-Conditioning, Heating and Refrigeration Institute:

1. AHRI 710 - Liquid-Line Driers.
2. AHRI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter Dryers.
3. AHRI 750 - Thermostatic Refrigerant Expansion Valves.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 15 - Safety Code for Mechanical Refrigeration.

- C. American Society of Mechanical Engineers:
 - 1. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B31.5 - Refrigeration Piping.
- D. ASTM International:
 - 1. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 - 2. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 3. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- E. American Welding Society:
 - 1. AWS A5.8 - Specification for Filler Metals for Brazing and Braze Welding.
- F. International Mechanical Code.

1.03 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves or equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.5.
- D. For VRF systems: all special fittings and accessories shall be provided by the VRF manufacturer.

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate layout of refrigeration piping system, including equipment, critical dimensions, and sizes.
- C. VRF Systems: Submit certifications for all installing technicians from VRF manufacturer.
- D. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings and accessories.
 - 2. Valves: Submit manufacturer's catalog information with valve data and ratings for

each service.

3. Hangers and Supports: Submit manufacturer's catalog information including load capacity.
4. Refrigerant Specialties: Submit manufacturer's catalog information including capacity, component sizes, rough-in requirements, and service sizes for the following:
 - a. Refrigerant moisture and liquid indicators.
 - b. Refrigerant filter-driers.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves, equipment and refrigerant accessories.
- C. Operation and Maintenance Data: Submit instructions for installation and changing components and exploded assembly views.
- D. Test Reports: Indicate results of refrigerant leak test.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with ASME B31.5 code for installation of refrigerant piping systems.
- B. Perform Work in accordance with the applicable code .

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Fabricator or Installer: Company specializing in performing Work of this section with minimum three years of experience.
- C. VRF Systems: All technicians must have certifications from VRF manufacturer.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Dehydrate and charge refrigeration components including piping and receivers, seal prior to shipment. Maintain seal until connected into system.
- C. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

PART 2 PRODUCTS

2.01 REFRIGERANT PIPING

- A. Copper Tubing: ASTM B280, Type ACR, drawn.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- B. Copper Tubing Less Than or Equal to 0.625 inch OD: ASTM B280, Type ACR, annealed.
 - 1. Fittings: ASME B16.22 wrought copper.
 - 2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.02 UNIONS, FLANGES AND COUPLINGS

- A. 2 inches and Smaller:
 - 1. Copper Pipe: Bronze, brazed joints.

2.03 PIPE HANGERS AND SUPPORTS

- A. Conform to ASME B31.5.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- C. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- D. Vertical Support: Steel riser clamp.
- E. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange.
- F. Copper Pipe Support: Carbon steel rings, adjustable, copper plated.
- G. Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

- H. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.
- I. Sheet Lead: ASTM B749, 0.039 inch thick.

2.04 REFRIGERANT MOISTURE AND LIQUID INDICATORS

- A. Indicators:
 - 1. Port: Single, UL listed.
 - 2. Body: Brass, with solder ends.
 - 3. Sight glass: Color-coded moisture indicator and plastic cap.
 - 4. Maximum working pressure: 500psig.
 - 5. Maximum working temperature: 200 degrees F.

2.05 VALVES

- A. Service Valves:
 - 1. Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, solder ends.
 - 2. Maximum working pressure: 500 psig.

2.06 REFRIGERANT FILTER-DRIERS

- A. Permanent Straight-Through Type:
 - 1. AHRI 710, UL listed, steel shell with molded desiccant filter core, for maximum working pressure of 500 psig.
 - 2. Rating: AHRI 730 flow capacity of nominal scheduled capacity served by line.

2.07 EXPANSION VALVES

- A. Provide with equipment. See equipment specification.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

3.02 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare piping connections to equipment with flanges or unions.
- D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

3.03 INSTALLATION – INSERTS

- A. Provide inserts for placement in concrete forms.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.04 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with ASME B31.5.
- B. Support horizontal piping hangers as scheduled.
- C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
- G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
- H. Provide sheet lead packing between hanger or support and piping.
- I. Prime coat exposed steel hangers and supports in accordance with Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.05 INSTALLATION – PIPING SYSTEMS

- A. All refrigerant charge capacities (pounds of refrigerant) shall be approved by the equipment manufacturer and include not only condensing units/heat pumps but line sets as well. The Contractor is responsible for measuring lineal feet both equivalent and

actual to ensure refrigerant charge is exact.

- B. Route piping parallel to building structure and maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space.
- D. Group piping whenever practical at common elevations.
- E. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- F. Install pipe identification in accordance with Section 23 05 53.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints or connected equipment.
- H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
- I. Arrange refrigerant piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required per manufacturer's instructions. Slope horizontal piping 0.40 percent in direction of flow.
- J. Flood refrigerant piping system with nitrogen when brazing.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welds.
- L. Install valves with stems upright or horizontal, not inverted.
- M. Insulate piping; refer to Section 23 07 00.
- N. Fully charge completed system with refrigerant after testing.
- O. Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- P. Install refrigerant piping in accordance with ASME B31.5.

3.06 INSTALLATION – REFRIGERANT SPECIALTIES

- A. Refrigerant Liquid Indicators:
 - 1. Install line size liquid indicators in main liquid line downstream of condenser.
- B. Refrigerant Valves:
 - 1. Install service valves on compressor suction and discharge.
 - 2. Install gauge taps at compressor inlet and outlet.
- C. Filter-Driers:

1. Install permanent filter-drier in systems containing hermetic compressors.

3.07 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Test refrigeration system in accordance with ASME B31.5.
- C. Pressure test refrigeration system with dry nitrogen to 500 psig.
- D. Repair leaks.
- E. Retest until no leaks are detected.

3.08 SCHEDULES

- A. Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	MINIMUM HANGER ROD DIAMETER COPPER TUBING Inches
1/2	5	3/8
3/4	5	3/8
1	6	3/8
1-1/4	7	3/8
1-1/2	8	3/8
2	8	3/8
2-1/2	9	1/2
3	10	1/2
4	10	1/2
5	10	1/2
6	10	5/8

END OF SECTION

SECTION 23 31 00 – HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Duct materials.
2. Insulated flexible ducts.
3. Single wall spiral round ducts.
4. Ductwork fabrication.
5. Duct cleaning.

B. Related Sections:

1. Section 03 30 00 - Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
2. Section 09 90 00 - Painting and Coating: Execution requirements for Weld priming, weather resistant, paint or coating specified by this section.
3. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
4. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.02 REFERENCES

A. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A90 - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
4. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
5. ASTM A568 - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.

6. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 7. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 8. ASTM1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 9. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 11. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation – Type II, Grade 1, Sheet Materials.
 12. ASTM C1534 – Specification for Flexible Polymeric Foam Sheet Insulation Used as Thermal and Sound Absorbing Liner for Duct Systems.
 13. ASTM G21/C1338 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 14. ASTM G22 – Standard Practice for Determining Resistance of Plastics to Bacteria.
- B. Greenguard Environmental Institute:
1. GEI - Greenguard Certification Standards for Low-Emitting Products.
- C. National Fire Protection Association:
1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
 2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
 3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- D. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - Fibrous Glass Duct Construction Standards, most recent edition.
 2. SMACNA - HVAC Air Duct Leakage Test Manual, most recent edition.
 3. SMACNA - HVAC Duct Construction Standard - Metal and Flexible, most recent edition.

- E. Underwriters Laboratories Inc.:
 - 1. UL 94 – Standard for Safety of Flammability of Plastic Materials .
 - 2. UL 181 - Factory-Made Air Ducts and Connectors.
- F. South Coast Air Quality Management District:
 - 1. SCAQMD Rule 1168 – Adhesive and Sealant Applications, amended January 7, 2005.
 - a. Metal to metal: Maximum VOC content 30 g/L.
- G. U.S. Environmental Protection Agency (EPA)
 - 1. EPA-registered antimicrobial agent for HVAC duct lining

1.03 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
 - 1. Fabrication, assembly and installation details, including plans, elevations, sections, details of components, and attachments to other work.
 - 2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
 - 3. Fittings.
 - 4. Reinforcing details and spacing.
 - 5. Seam and joint construction details.
 - 6. Penetrations through fire rated and other walls.
 - 7. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- C. Product Data: Submit data for duct materials, duct liner and duct connectors.
- D. Duct Pressure Test Form.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.
- C. Duct Pressure Test Report: Indicate pressure tests performed. Include date, section tested, duct design static pressure, test apparatus information (model, fan HP, orifice calibration certificate) test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual, most recent edition.

1.06 SUSTAINABLE DESIGN SUBMITTALS

- A. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify recycled material content for recycled content products.
 - b. Certify source for local and regional materials and distance from project site.
 - 2. Indoor Air Quality Certificates:
 - a. Certify volatile organic compound content for each interior adhesive and sealant, related primer and waterproof coating.

1.07 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
- B. Construct ductwork to NFPA 90A standards and in accordance with applicable mechanical code.
- C. Construct kitchen grease exhaust ductwork to NFPA 96 standards and in accordance with applicable mechanical code.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years of experience.

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install duct sealant when temperatures are less than those recommended by

sealant manufacturers.

- C. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.01 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90.
- B. Steel Ducts: ASTM A1008, ASTM A1011 or ASTM A568.
- C. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.
- D. Stainless Steel Ducts: ASTM A240 or ASTM A666, Type 316.
- E. Fasteners: Rivets, bolts or sheet metal screws.
- F. Hanger Rod: ASTM A36; carbon steel or galvanized; threaded both ends, threaded one end, or continuously threaded.
- G. Duct Sealants: Fire-resistive, water-based, indoor/outdoor, U.V.-resistant, non-fibrous sealant for use on low-, medium- and high-velocity duct seams. Foster 32-19; Childers CP-146; Duro Dyne SAS UL.
- H. Adhesive: Water based. Used to adhere duct liner and/or duct Wrap (up to 3#/cu. ft.) to metal. Foster 85-60, Childers CP-127, Duro Dyne SSG

2.02 ACOUSTIC INSULATED FLEXIBLE DUCTS

- A. Manufacturers & Product:
 - 1. Flexmaster – Type 1M
 - 2. Thermaflex – model M-KE
- B. Product Description: UL 181, Class 1, acoustically transparent core, polyethylene liner locked to a helical wound spring steel wire; fiberglass insulation; reinforced, aluminized vapor barrier film.
 - 1. Pressure Rating:
 - a. 10 inches w.g. positive and 1.0 inch w.g. negative through 12-inch diameter.
 - b. 6 inches w.g. positive and 0.5 inch w.g. negative for 14- through 16-inch diameter.

- c. 4 inches w.g. positive and 0.5 inch w.g. negative for 18- and 20-inch diameter.
2. Maximum Velocity: 5000 fpm.
3. Temperature Range: -20 degrees F to 250 degrees F.
4. Thermal Resistance: 6 square feet-hour-degree F per BTU.

2.03 SINGLE WALL SPIRAL ROUND DUCTS

- A. Product Description: UL 181, Class 1, round or flat oval spiral lockseam duct with light reinforcing corrugations.
- B. Construct round or oval duct in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, most recent edition and as indicated on Drawings. Provide duct material, gauges, reinforcing and sealing for operating pressures indicated.
- C. Fabricate continuously welded round duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- D. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- E. All elbows 45-degree and 90-degree shall be die-stamped for less than or equal to 10 inches diameter. Elbows greater than 10 inches diameter shall be of the gored type and according to the following: 30-degree shall be 2-gore, 45-degree shall be 3-gore and 90-degree shall be 5-gore.
- F. Seal joints between duct sections and duct seams with mastic adhesive regardless of duct pressure classification.
 1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 2. Do not provide sealing products not bearing UL approval markings.
- G. Exposed ductwork to be painted shall have a matte, paint-grip finish.

2.04 RECTANGULAR DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and [as indicated on Drawings]. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation. Provide access door upstream of all turning vanes for inspection and cleaning.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence

downstream.

- D. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- E. Seal joints between duct sections and duct seams with gasket and/or mastic adhesives, regardless of duct pressure classification.
 - 1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 - 2. Do not provide sealing products not bearing UL approval markings.
- F. Offsets shall be radius ogee type where possible. Where space does not allow radius ogee offsets, shop-fabricated mitered offsets with a maximum 30 degree offset angle shall be used.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify sizes of equipment connections before fabricating transitions.

3.02 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. During construction, install temporary closures of metal or taped polyethylene on all open ductwork, installed or in storage, to prevent construction dust from entering ductwork system.
- C. Duct inlet and outlet areas shall be clean and free of dirt, oil and other bond inhibiting contaminants.
- D. Install duct hangers and supports in accordance with SMACNA Duct Construction Standards.
- E. Use double nuts and lock washers on threaded rod supports.
- F. Connect flexible ducts to metal ducts with nylon draw bands on inner jacket and outer vapor barrier. Finish with mastic adhesive.
- G. Install in accordance with manufacturer's instructions.
- H. Duct sizes are inside clear dimensions.
- I. Located ducts with sufficient space around equipment to allow normal operating and maintenance activities.

- J. For outdoor ductwork, protect ductwork, ductwork supports, linings and coverings from weather.
- K. All ductwork that is exposed shall be joined with gasketed couplings. For metal to metal joining that cannot be gasketed shall be sealed from the inside. Sealant should not be visible to the end user.
- L. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp unless indicated otherwise.
- C. Connect air outlets and inlets to supply ducts with five foot maximum length of flexible duct. If flexible duct is used to change direction, the cross sectional profile of the flexible duct should be maintained.
- D. Where exposed ductwork penetrates a ceiling or wall in finished spaces, install sectional plates or escutcheons to cover the annular opening between pipe and sleeve. Solid plates with set screws shall be used where the sectional plates will not stay in place or are not available in the required size, or where other individual specification section(s) require one piece or greater quality escutcheons or plates. Refer to Section 23 00 01 for additional requirements.

3.04 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- C. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

3.05 TESTING

- A. For ductwork designed for 3 inches w.c. or above ambient per pressure class schedule below, pressure test minimum 25 percent of ductwork after duct cleaning, but before duct insulation is applied or ductwork is concealed.
 - 1. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2. Maximum Allowable Leakage: In accordance with applicable, local code.

3.06 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Interior Supply	Galvanized Steel
Interior Return and Relief	Galvanized Steel
General Exhaust	Galvanized Steel, Aluminum

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Supply	2 inch w.g.
Return and Relief	2 inch w.g.
Outside Air Intake	2 inch w.g.
General Exhaust	2 inch w.g.

END OF SECTION

SECTION 23 33 00 – AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Branch duct take-off fittings.
2. Back-draft dampers.
3. Dynamic fire dampers – curtain blade type.
4. Manual volume balancing dampers.
5. Flexible duct connectors.
6. Duct access doors.
7. Duct test holes.

B. Related Sections:

1. Section 23 31 00 – HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.

1.02 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters.

B. National Fire Protection Association:

1. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA – HVAC Duct Construction Standard - Metal and Flexible.
2. SMACNA – Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems.

D. Underwriters Laboratories Inc.:

1. UL 555 – Standard for Safety for Fire Dampers.

1.03 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.

- C. Product Data: Submit data for shop fabricated assemblies and hardware used.
- D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 - 1. Air device take-offs.
 - 2. Fire dampers including locations and ratings.
 - 3. Backdraft dampers.
 - 4. Flexible duct connectors.
 - 5. Volume control dampers.
 - 6. Duct access doors.
- E. Product Data: For fire dampers submit the following:
 - 1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
 - 2. Indicate materials, construction, dimensions, and installation details.
 - 3. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
 - 4. Manufacturer's Installation Instructions: Submit for each damper type.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of access doors and test holes.

1.05 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 – Product Requirements: Product storage and handling requirements.
- B. Protect dampers from damage to operating linkages and blades.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

- D. Storage: Store materials in a dry area indoor, protected from damage. Products on site, but not yet installed shall be stored in boxes. The open airside ends of installed equipment shall be plastic wrapped during construction.
- E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 COORDINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work where appropriate with building control Work.

1.10 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two fire damper fusible links of each size and type.

PART 2 PRODUCTS

2.01 BRANCH DUCT TAKE-OFF FITTINGS

- A. Provide all branch duct take-off fittings with construction that is suitable for the duct pressure class as scheduled in section 23 31 00, HVAC Ducts and Casings. Fittings shall be minimum 24-gauge galvanized sheet metal. If trunk ductwork is fabricated from aluminum or stainless steel, takeoffs shall be manufactured from same material.
- B. All branch duct take-off fittings serving air devices shall be provided with a manual volume damper equal to Flexmaster model BO3 with 3/8" aluminum square shaft secured to damper blade with U-bolts, nylon bushings, locking quadrant and 2-inch build out for insulation. (The 2-inch build out is not required on uninsulated ductwork.)
- C. All branch duct take-off fittings serving terminal units shall be provided without a volume damper.
- D. Branch duct take-offs from rectangular ductwork: Fittings shall be constructed for up to 4" w.g pressure rating, with all seams sealed. Connection to trunk duct shall be rectangular in shape with a 45° entry and shall have 1-inch flanges with double-sided adhesive gasket.

Transition from rectangular to round branch shall be in an eccentric and tapered configuration. Take-off fittings shall be equal to Flexmaster model STO.

- E. Optional branch duct take-offs from rectangular ductwork: Fittings shall be constructed for up to 4" w.g pressure rating, with all seams sealed. Connection to trunk duct shall be round in shape with a conical entry and shall have 1-inch flanges with double-sided adhesive gasket. Take-off fittings shall be equal to Flexmaster model CB-SOG.
- F. Branch duct take-offs from round ductwork: Provide saddle tap take-off fitting for spiral duct sizes up to 24" diameter. Fitting shall have rectangular to round outlet and constructed for up to 4" w.g. pressure rating. Fitting shall transition from rectangular to round in an eccentric and tapered configuration. Fitting shall be equal to Flexmaster model STO-ST 90° or model STO-ST 45°.
- G. Branch duct take-offs from round ductwork with duct pressure class exceeding 4" w.g.: Fitting shall be designed to be low loss and have contoured saddle tap for connection to either a flat oval or round duct as indicated on the drawings. The fitting outlet shall transition to round duct. Fitting shall be a United McGill Model "SADDLE LO-LOSS TEE TAP" or equal.

2.02 BACK-DRAFT DAMPERS

- A. Extruded aluminum multi-blade, back-draft dampers: Parallel-action, gravity-balanced, with adjustable counterbalance weights to permit setting for varying differential static pressure.
- B. Ratings:
 - 1. Leakage: Dampers shall have a maximum leakage of 15 CFM at 1 in. W.G., tested in accordance with AMCA standard 500-D.
 - 2. Differential Pressure: Dampers shall have a maximum differential pressure rating of 2.5 in. W.G.
 - 3. Velocity: Dampers shall have a maximum velocity rating of 2000 FPM.
- C. Construction:
 - 1. Frame: 0.063 in. extruded aluminum.
 - 2. Blades: .050 in. extruded aluminum.
 - 3. Seals: Blade edge seals shall be vinyl, mechanically fastened to each blade.
 - 4. Linkage: On blade, plated steel material.
 - 5. Axles: Aluminum.
 - 6. Bearings: Axle bearings shall be synthetic polycarbonate sleeve.
 - 7. Finish: Mill finish.

2.03 DYNAMIC FIRE DAMPERS – CURTAIN BLADE TYPE

- A. Fabricate in accordance with NFPA 90A and UL 555.

- B. Fire Resistance: 1-1/2 hour or 3 hour as required. Refer to the Architectural Life Safety drawing for wall, partition and floor ratings.
- C. Dynamic Closure Rating: Dampers classified for dynamic closure to 2000 fpm and 4 inches wg static pressure.
- D. Construction:
 - 1. Integral Sleeve Frame: Roll formed galvanized steel, in gauge required by UL listing.
 - 2. Blades:
 - a. Style: Curtain type
 - b. Action: Spring or gravity closure upon fusible link release.
 - c. Material: Roll formed, galvanized steel, in gauge required by UL listing.
 - 3. Closure Springs: Stainless steel, constant force type.
- E. Fusible Link Release Temperature: 165 degrees F.
- F. Mounting: Vertical or horizontal as indicated on Drawings.
- G. Duct Transition Connection, for Curtain Damper Style:
 - 1. B style - rectangular connection, blades out of air stream, high free area.
 - 2. CR style - round connection, blades out of air stream, sealed.
 - 3. CO style - oval connection, blades out of air stream, sealed.
 - 4. Style A Grille Mount - Out of wall damper for use at sidewall grilles, blades in air stream; 1-1/2 hour UL555 rated.
- H. Finish: Mill galvanized.
- I. Provide factory-assembled multiple section dampers where required sizes exceed maximum single section damper size.

2.04 MANUAL VOLUME BALANCING DAMPERS

- A. Fabricate in accordance with current SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- B. Rectangular Dampers:
 - 1. Single Blade Dampers: Duct sizes up to 36 inches in width. Blade dimension perpendicular to the axle rod shall be a maximum of 12 inches, for dimensions greater than 12 inches use a multi-blade damper. Furnish with 20 gauge galvanized steel blade, continuous axle rod and end bearings.
 - 2. Multi-Blade Damper: Fabricate of opposed blade pattern with a maximum blade size of 8 x 48 inches. Assemble center and edge crimped blades in prime coated

or galvanized frame channel with suitable hardware. Blades shall be minimum 18 gauge galvanized steel and frame shall be minimum 16 gauge galvanized steel.

3. End Bearings: Furnish for single and multiple blade dampers. On multiple blade dampers, furnish synthetic or bronze bearings.
4. Quadrants:
 - a. Furnish locking, indicating quadrant regulators on dampers.
 - b. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
 - c. Where rod lengths exceed 30 inches furnish regulator at both ends.
- C. Round Dampers: Sleeve and blade shall be G90 galvanized steel construction, manufactured from 24 gauge or heavier material as required to meet SMACNA for commercial construction. Provide a continuous 3/8" square shaft secured to damper blade with u-bolt(s). Provide with nylon bearings, locking quadrant and 2-inch build out for insulation. Damper shall be Flexmaster Model SL with BO3 build out or equal.
- D. Concealed quadrant regulators:
 1. Manufacturers:
 - a. Young Regulator Co.
 - b. Metropolitan Air Technology.
 - c. Vent Fabrics.
 - d. Or equal.
 2. Locations: Provide on round and rectangular dampers in the following locations:
 - a. Where damper regulator is located above an inaccessible ceiling (i.e. gypsum board) and a ceiling access door is not provided.
 - b. Where the quadrant regulator is remote and is not accessible via a ceiling access door or by removal of a lay-in ceiling panel.
 - c. As indicated on the drawing.
 3. Flexible Cable Type Regulator:
 - a. Regulator shall consist of a remote cable control system with 1/4" rotary motion flexible steel shaft for control of round and rectangular dampers.
 - b. Provide with mounting controls, ceiling cup and hardware as required for installation of control mechanism in gypsum board ceiling, unless indicated on the drawings for the control mechanism(s) to terminate at a central control station.

2.05 FLEXIBLE DUCT CONNECTORS

- A. Fabricate in accordance with current SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.
- B. Connector: Fabric crimped into metal edging strip.

1. Fabric:
 - a. Indoor Applications: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - b. Outdoor Applications: UL listed fire-retardant hypalon coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.; product shall be intended for outdoor, exposed-to-weather applications.
2. Net Fabric Width: Approximately 3 inches wide.
3. Metal: 3 inch wide, 24 gauge galvanized steel.
4. Pressure Rating: min. 10" W.G.

2.06 DUCT ACCESS DOORS

- A. Access doors for rectangular, round and oval ductwork shall be Ductmate model Sandwich Access Doors or equal.
- B. Fabrication: Sandwich-style insulated access door.
 1. Panels: The insulated sandwich access door shall consist of three layers of precision stamped steel. The inside panel shall consist of two layers of metal which are spot welded together along the rim encapsulating high density fiberglass insulation with Ecosse Technology UL classified FHC25/50.
 2. Gasket: Closed-cell neoprene gasket UL94HF1 listed with a service temperature range of (ASTM D746) -20 degrees F to 200 degrees F. The gasket shall be bonded to the inside of the door.
 3. Springs: Zinc-plated conical springs shall be installed, between the inner and outer door, to facilitate opening.
 4. Knobs: Polypropylene molded knobs shall have threaded metal inserts to eliminate thread stripping. Knobs shall be easily turned by hand. Knobs shall be UL94HB listed.
 5. Bolts: Zinc plated carriage bolts are secured to inner door.
 6. Template: Self-adhesive template shall be provided for the exact size of duct opening required.
 7. Available Door sizes:
 - a. 8" x 4"
 - b. 10" x 6" (rectangular and oval duct only)
 - c. 12" x 8"
 - d. 16" x 12"
 - e. 18" x 14"
 - f. 24" x 18"

8. Access Door Sizes: Provide the largest door, from the sizes herein specified, that the duct size as indicated on the drawing can accommodate.

2.01 DUCT TEST HOLES

- A. Permanent Test Holes: Factory fabricated, air-tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.
- B. Temporary Test Holes: Drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

PART 3 EXECUTION

1.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify fire and smoke rated walls are ready for damper installation.
- C. Verify ducts and equipment installation is ready for accessories.
- D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

1.02 INSTALLATION

- A. Install in accordance with NFPA 90A and follow current SMACNA HVAC Duct Construction Standards – Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Install back-draft dampers on exhaust ducts nearest to the outside and where indicated on Drawings.
- C. Adjust back-draft damper counterbalance weights to open damper with minimal differential pressure.
- D. Access Doors: Install access doors at the following locations and as indicated on Drawings:
 1. Spaced every 20 feet of horizontal return air duct as required by NFPA 90A.
 2. Upstream of each duct mounted filter.
 3. Upstream of each duct mounted coil.
 4. Upstream of each duct mounted air flow measuring station.
 5. At each automatic control damper, on same side as damper actuator.
 6. At each backdraft damper.
 - a. Access door shall allow for access to adjust counterbalance weights.
 7. At each fire damper.
 - a. Access door shall allow for access to all components, provide additional doors as necessary.

- b. Access doors shall be labeled, with minimum ½" high letters, to identify location and type of fire protection device within, in accordance with NFPA and the locally adopted mechanical code.
- E. Access Door Sizes: Provide the largest door, from the sizes herein specified, that the duct size as indicated on the drawing can accommodate.
- F. Install temporary duct test holes where indicated on Drawings and required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- G. Install permanent duct test holes where indicated on Drawings and required for testing and balancing purposes.
- H. Install all dampers at locations as indicated on Drawings.
- I. Install dampers square and free from racking with blades running horizontally.
- J. Do not compress or stretch damper frame into duct or opening.
- K. Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jack shaft.
- L. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
- M. Provide identification at each access door.
- N. Install fire dampers in accordance with manufacturer's UL approved instructions, applicable building and mechanical codes, NFPA 90A and SMACNA Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems. Install with required perimeter retaining angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- O. Provide flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- P. Provide balancing dampers where indicated on the drawings and as required for air balancing where branch ducts are taken from larger ducts at points on: constant volume supply air systems; supply air system downstream of air terminal units; return air systems and exhaust air systems.
- Q. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

1.03 DEMONSTRATION

- A. Section 01 70 00 – Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate re-setting of fire dampers to Owner's representative.

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END OF SECTION

SECTION 23 34 00 – HVAC FANS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Roof-mounted downblast centrifugal exhaust fans

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment: Roof curbs.
3. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
4. Section 23 31 00 - HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
5. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
6. Section 26 05 03 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.02 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

- C. American National Standards Institute:
 - 1. ANSI S1.4 – Specifications for Sound Level Meters
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. Underwriters Laboratories Inc.:
 - 1. UL 705 - Power Ventilators.

1.02 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified design and maximum and minimum operating points plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity (measured in accordance with ANSI S1.4), electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.03 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.04 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured and tested in accordance with UL 705.
- D. Balance Quality: Conform to AMCA 204.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years of documented experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect motors, shafts and bearings from weather and construction dust.

1.07 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.08 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five-year manufacturer's warranty for fans.

1.09 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

1.10 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of belts for each belt-driven fan.

PART 2 PRODUCTS

2.01 ROOF-MOUNTED DOWNBLAST CENTRIFUGAL EXHAUST FANS

- A. General Description:
 - 1. Downblast centrifugal fan shall be for roof mounted applications.
 - 2. Motor drive type (i.e. belt-driven and direct-driven) – as scheduled in the Drawings.
 - 3. Maximum continuous operating temperature shall be 180°F.
 - 4. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number.
- B. Wheel:
 - 1. Constructed of aluminum.
 - 2. Non-overloading, backward inclined centrifugal.
 - 3. Statically and dynamically balanced in accordance to AMCA Standard 204-05.

4. The wheel cone and fan inlet shall be matched and shall have precise running tolerances for maximum performance and operating efficiency.
- C. Motors:
1. Motor shall meet all specified requirements in section 23 05 13.
 2. Motors shall be accessible for maintenance.
- D. Housing:
1. Motor cover, shroud, curb cap, and lower windband shall be constructed of heavy gauge aluminum.
 2. Shroud shall have an integral rolled bead for extra strength.
 3. Shroud shall be drawn from a disc and direct air downward.
 4. Lower windband shall have a formed edge for added strength.
 5. Motor cover shall be drawn from a disc.
 6. All housing components shall have final thicknesses equal to or greater than preformed thickness.
 7. Curb cap shall have pre-punched mounting holes to ensure correct attachment.
 8. Rigid internal support structure.
 9. Leak proof.
- E. Shafts and Bearings (For Belt-Driven Fans):
1. Fan shaft shall be ground and polished solid steel with an anti-corrosive coating.
 2. Permanently sealed bearings or pillow block ball bearings.
 3. Bearing shall be selected for a minimum L10 life in excess of 100,000 hours (equivalent to L50 average life of 500,000 hours), at maximum cataloged operating speed.
 4. Bearings shall be 100 percent factory tested.
 5. Fan shaft first critical speed is at least 25 percent over maximum operating speed.
- F. Housing Supports and Drive Frame (For Belt-Driven Fans):
1. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
- G. Drive Assembly (For Belt-Driven Fans):
1. Belts, pulleys and keys oversized for a minimum of 150 percent of driven horsepower.
 2. Belts: Static free and oil resistant.
 3. Fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.
 4. The motor pulley shall be adjustable for final system balancing.

5. Readily accessible for maintenance.
- H. Vibration Isolation:
1. Double studded or pedestal mount true isolators
 2. No metal to metal contact.
 3. Sized to match the weight of each fan.
- I. Disconnect Switches:
1. NEMA rated: 3R.
 2. Positive electrical shut-off.
 3. Wired from fan motor to junction box installed within motor compartment.
- J. Accessories:
1. Bird screen:
 - a. Material Type: Aluminum.
 - b. Protects fan discharge.
 2. Roof Curbs: See Section 23 05 29.
 3. Curb Seal:
 - a. Rubber seal between the fan and the roof curb.
 4. Dampers:
 - a. Type: Gravity.
 - b. Prevents outside air from entering back into the building when fan is off.
 - c. Balanced for minimal resistance to flow.
 - d. Galvanized frames with pre-punched mounting holes.
 - e. Provide with opening for conduit up through base.
 5. Finishes: None.
 6. Auto Belt Tensioner (For Belt-Driven Fans):
 - a. Automatic tensioning device that adjusts for the correct belt tension, only for single drives.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify roof curbs are installed and dimensions are as instructed by manufacturer.
- C. Examine areas to receive fans. Notify the Engineer of conditions that would adversely

affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Furnish roof curbs per Section 23 05 29 for installation.
- B. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance.
- C. Ensure duct is plumb, sized correctly, and to proper elevation above roof deck.

3.03 INSTALLATION

- A. Install fans in accordance with manufacturer's Installation, Operation and Maintenance Manual (IOM) and contract drawings.
- B. Secure roof fans with stainless steel lag screws to roof curb or structure.
- C. Suspended Inline Fans: Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one-inch flex between ductwork and fan while running.
- D. Install backdraft dampers on inlet to roof exhaust fans.
- E. Install safety screen where inlet or outlet is exposed.
- F. Pipe scroll drains to nearest floor drain for indoor utility vent set fans.
- G. Install backdraft dampers on discharge of exhaust fans and as indicated on Drawings. Refer to Section 23 33 00.
- H. For belt-driven fans, provide sheaves required for final air balance.

3.04 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish services of factory trained representative for minimum of one day to start-up, calibrate controls, and instruct Owner on operation and maintenance.

3.05 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction.
- C. Vacuum clean inside of fan cabinet.

3.06 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.

- B. Demonstrate fan operation and maintenance procedures.

3.07 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect installed product and finished surfaces from damage during construction.
- C. Do not operate fans until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.
- D. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 23 37 00 – AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Indoor air devices.

B. Related Sections:

1. Section 09 90 00 – Painting and Coating: Execution and product requirements for Painting of ductwork visible behind outlets and inlets specified by this section.
2. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment: Roof curbs.
3. Section 23 31 00 – HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.
4. Section 23 33 00 – Air Duct Accessories: Volume dampers for inlets and outlets.

1.02 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 70 – Method of Testing for Rating the Performance of Air Outlets and Inlets.

C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA – HVAC Duct Construction Standard – Metal and Flexible.

1.03 SUBMITTALS

A. Section 01 33 00 – Submittal Procedures: Submittal procedures.

B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

C. Test Reports: Rating of air outlet and inlet performance.

D. Submit manufacturer's installation instructions under provisions of Section 01 33 00 – Submittal Procedures.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of air outlets and inlets.

1.05 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.07 WARRANTY

- A. Section 01 70 00 – Execution and Closeout Requirements: Product warranties and product bonds.

1.08 EXTRA MATERIALS

- A. Section 01 70 00 – Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Price.**
- B. Titus.
- C. Substitutions: Section 01 60 00 – Product Requirements.

2.02 INDOOR AIR DEVICES – As Scheduled.

2.03 SCHEDULES – See Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 – Administrative Requirements: Coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling and wall systems are ready for installation.

3.02 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 90 00.
- D. Install items in accordance with manufacturer's instructions.
- E. Insulate tops of all supply ceiling diffusers with min R-6 flexible duct insulation with vapor barrier.
- F. Install return and exhaust register with blades to minimize sight through outlets or inlets.
- G. Locations of air distribution devices on Drawings are approximate and shall be coordinated with other trades to make symmetrical pattern and shall be influenced by the established general pattern of the lighting fixtures or architectural reflected ceiling plan, but primarily located to maintain proper air distribution.
- H. Provide all specialties and frames for air distribution devices as required for proper installation in ceiling type as indicated on the architectural drawings. Provide all cutting and patching of T-bars, gypsum board, and other ceilings systems as required for installation of air devices.
- I. Install supply and return devices with a minimum of 24" separation.
- J. Integral OBDs shall be installed fully open and only adjusted if tap dampers are inaccessible or it is necessary for balancing.

3.03 INTERFACE WITH OTHER PRODUCTS

- A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

SECTION 23 40 00 – HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Disposable, extended area panel filters (MERV 8 or MERV 13).

B. Related Sections:

1. Section 23 81 10 – Packaged DX Outdoor Air Units.
2. Section 23 81 27 – Variable Refrigerant Flow Outdoor Units.
3. Section 23 81 28 – Variable Refrigerant Flow Indoor Units (manufacturer's built-in filters as specified there and scheduled on the Drawings).

1.02 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. AHRI 850 - Commercial and Industrial Air Filter Equipment.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
2. ASHRAE 62.1 – Ventilation for Acceptable Indoor Air Quality.

C. National Fire Protection Association

1. NFPA 70 – National Electrical Code

D. Underwriters Laboratories Inc.:

1. UL 900 - Air Filter Units.

1.03 PERFORMANCE REQUIREMENTS AND QUALITY ASSURANCE

A. Conform to AHRI 850 Section 7.4.

B. Dust Spot Efficiency: Plus or minus 5 percent.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.

- C. Product Data: Submit data on filter media, filter performance data, dimensions, and electrical characteristics.
- D. Manufacturer's Installation Instructions: Submit assembly and change-out procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for operation, changing and periodic cleaning.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years of documented experience.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver in factory fabricated shipping containers. Identify on outside of container type of product and location to be installed. Avoid crushing or bending.
- B. Store in original cartons and protect from weather and construction work traffic.
- C. Store indoors and in accordance with the manufacturers' recommendation for storage

1.08 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.09 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of filters for each filter bank.

PART 2 PRODUCTS

2.01 DISPOSABLE, EXTENDED AREA PANEL FILTERS (MERV 8 or MERV 13)

- A. Media: UL 900 Classified, pleated, lofted, non-woven fabric supported and bonded to expanded metal mesh.
 - 1. Frame: Water-resistant cardboard.
 - 2. Nominal thickness: 2 inches.

- B. Rating, ASHRAE 52.2:
 - 1. Minimum efficiency rating value: MERV 8 or MERV 13 as indicated on Drawings.
 - 2. Arrestance value: >90 percent.
 - 3. Initial resistance at 500 fpm face velocity: 0.35 inch.
 - 4. Recommended final resistance: 0.7-inch w.g.
 - 5. Maximum continuous operating temperature: 160 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION - FILTERS

- C. Install air cleaning devices in accordance with manufacturer's instructions.
- D. Install filters with felt, rubber or neoprene gaskets to prevent passage of unfiltered air around filters.
- E. Install filter gauge static pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.
- F. Provide temporary filters for system start-up. Install filter media over all return air duct openings when fans are operated during construction activities. Do not operate fan system until temporary or permanent filters are in place. Replace temporary filters used during construction and testing, with clean set.

END OF SECTION

SECTION 23 81 10 – PACKAGED DX OUTDOOR AIR UNITS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Packaged variable volume rooftop air conditioning units.
- B. Related Sections:
 - 1. Section 23 05 29 – Hangers and Supports for HVAC Piping and Equipment: Requirements for roof curbs provided with equipment.
 - 2. Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment: Vibration isolators.
 - 3. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
 - 4. Section 23 21 13 – Condensate Piping
 - 5. Section 23 33 00 - Air Duct Accessories: Flexible connections.
 - 6. Section 26 05 03 - Equipment Wiring Connections: Electrical connection to units.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. AHRI 210/240 – Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment (up to 65,000 BTUh).
 - 2. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
 - 3. AHRI 340/360 - Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment (between 65,000 and 135,000 BTUh).
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 37 – Methods of Testing for Rating Electrically Driven Unitary Air-Conditioning and Heat Pump Equipment.
 - 2. ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 3. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality.
 - 4. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ASTM International:
 - 1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
- E. International Association of Plumbing and Mechanical Officials:

1. Uniform Mechanical Code.
2. Uniform Plumbing Code.
- F. International Code Council:
 1. International Energy Conservation Code.
- G. National Fire Protection Association:
 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 DEFINITIONS

- A. Energy Efficiency Ratio (EER) - Ratio of cooling capacity in Btuh to power input in watts at any set or rating conditions.
- B. Seasonal Energy Efficiency Ratio (SEER) – Ratio of cooling capacity in BTUh to total operating power input in watts, designated Standard Rating Conditions, expressed in BTU/W*h.
- C. Integrated Energy Efficiency Ratio (IEER) – A weighted calculation of cooling efficiencies at full load and part-load Standard Rating Conditions (in Btu/Wh).

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data indicating:
 1. Cooling and heating capacities per AHRI conditions and capacities at site specific conditions, as scheduled on Drawings.
 2. Efficiency ratings (EER, SEER or IEER) at AHRI Standard Rating Conditions.
 3. Efficiency rating (EER) at site specific conditions
 4. Dimensions.
 5. Weights.
 6. Rough-in connections and connection requirements.
 7. Duct connections.
 8. Electrical requirements with electrical characteristics and connection requirements.
 9. Controls.
 10. Accessories.
 11. Sound data – provide unweighted sound power levels for each octave band between 63Hz and 4000Hz.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of controls installed remotely from units.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.06 QUALITY ASSURANCE

- A. Cooling Capacity: Rate in accordance with AHRI 210/240 and AHRI 340/360.
- B. Sound Rating: Measure in accordance with AHRI 270.
- C. Insulation and adhesives: Meet requirements of NFPA 90A.
- D. Performance Requirements: Conform to minimum EER and SEER prescribed by the International Energy Conservation Code or ASHRAE 90.1 when tested in accordance with AHRI 210/240 and AHRI 340/360.
- E. Outside Air Damper Leakage: Test in accordance with AMCA 500.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept units on site. Inspect for damage.
- C. Protect units from damage by storing off roof until roof mounting curbs are in place.

1.09 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer's warranty for compressors.

1.11 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.

1.12 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of spare filters for each unit.

PART 2 PRODUCTS

2.01 PACKAGED ROOFTOP VARIABLE VOLUME OUTDOOR AIR UNITS

- A. Manufacturers:
1. **Aeon, Inc.**
 2. The Trane Company
 3. Daikin Applied
 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Self-contained, packaged, factory assembled and wired, consisting of roof curb, cabinet, variable speed supply fan, refrigerant cooling coil, variable capacity compressor, refrigeration circuit, condenser, heating section as scheduled in the Drawings, air filters, mixed air casing, controls, and accessories.
- C. Configuration: Downflow or horizontal air delivery as indicated on Drawings.
- D. Roof Mounting Curb: curb to be provided with equipment; refer to Section 23 05 29 for curb requirements.
- E. Cabinet:
1. Designed for outdoor installation with weatherproof construction.
 2. Doors: Provide insulated, hinged access doors with quarter-turn handles to access all sections of the air handler.
 3. Panels: Constructed of galvanized steel with baked enamel finish meeting salt spray test in accordance with ASTM B117. Furnish removable access panels where access doors are not provided.
 4. Insulation: Factory applied to exposed vertical and horizontal panels. Provide aluminum foil faced glass fiber with edges protected from erosion or closed cell foam, with a minimum total thermal resistance value of R-4.
- F. Supply Fan: Centrifugal type, resiliently mounted with direct drive EC motor, as scheduled. Motor permanently lubricated with built-in thermal overload protection.

- G. Evaporator Coil: Constructed of copper tubes expanded onto aluminum fins. Stainless steel drain pan with piping connection. Factory leak tested under water.
- H. Hot-Gas Reheat Coil: Provide hot-gas reheat coil, piping and valves to provide humidity control, where scheduled in the Drawings.
- I. Compressor: Inverter variable speed compressor; digital scroll or non-modulating compressor is not acceptable. All compressors shall be hermetically sealed, resiliently mounted with positive lubrication, and internal motor overload protection. Furnish internal vibration isolators and short cycle protection.
- J. Refrigeration circuit: Furnish the following for each circuit, thermal expansion valve, filter-drier, suction, discharge, and liquid line service valves with gauge ports, high and low pressure safety controls. Dehydrate and factory charge each circuit with oil and refrigerant.
- K. Condenser:
 - 1. Coil: Copper tube aluminum coil assembly or aluminum micro-channel assembly and galvanized steel hail guard. Factory leak tested under water.
 - 2. Condenser Fan: Direct drive propeller fans statically and dynamically balanced. Wired to operate with compressor. Motor permanently lubricated with built-in thermal overload protection. Furnish high efficiency fan motors.
- L. Electric Heating Section:
 - 1. Helical nickel-chrome resistance wire coil heating elements with refractory ceramic support bushings easily accessible with automatic reset thermal cut-out, built-in contactors, galvanized steel frame, manual reset thermal cut-out, load fuses. SCR fully modulating control.
 - 2. Controls: Start supply fan before electric elements are energized and continue operating until air temperature reaches minimum setting, with airflow proving switch for continuous fan operation.
- M. Air Filters: 2 inch thick glass fiber disposable media in metal frames. MERV 13 efficiency based on ASHRAE 52.2.
- N. Mixed Air Casing:
 - 1. Outside Air Damper Leakage: Maximum 3.0 cfm per square foot at 1.0 inches wg pressure differential.
 - 2. Outside Air Damper: 0-100% motorized modulating damper with spring return and without actuator. Furnish rain hood with screen.
- O. Controls:
 - 1. Provide terminal strip for BAS controller.
 - 2. Units shall be controlled as noted on the control sequences in the Drawings.
 - 3. Furnish control to provide low ambient cooling to 0 degrees F.

4. Provide factory wired float switch in drain pan to de-energize unit when the primary condensate drain is clogged.
- P. Accessories:
1. Convenience Outlet: Factory installed, 115 volt, 15 amp, GFCI type, internally mounted.
 2. Hail Guard: Provide factory installed hail guard for any exposed condenser coils.
- Q. Capacity: See Schedule on Drawings.
- R. Electrical Characteristics and Components: In accordance with Section 26 05 03 and as scheduled.
1. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.
 2. Electrical Connection: The unit shall have capability of single point power supply connection from below, up through the roof level.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify roof curbs are installed and dimensions are as instructed by manufacturer.

3.02 INSTALLATION

- A. Outside air intakes shall be located minimum 10 feet away from all exhaust outlets, including plumbing vents; Contractor shall coordinate with plumbing trade to offset vents as required.
- B. Roof Curb:
 1. Assemble roof curb.
 2. Install roof curb level.
 3. Coordinate curb installation and flashing with specified roofing system.
 4. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
 5. Install gasket material between unit base and roof curb.
- C. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.
- D. Install condensate piping with trap and route from drain pan as shown on Drawings. Refer to Section 23 05 29 for supports.
- E. Install components furnished loose for field mounting.

- F. Install electrical devices furnished loose for field mounting.
- G. Install control wiring between unit and field installed accessories.
- H. Any panels permanently removed from units during installation shall be removed from roof and dispose off-site.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish initial start-up for all rooftop units. Provide manufacturer's start-up report for each unit.

3.04 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Vacuum clean coils and inside of unit cabinet.
- C. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.05 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate unit operation and maintenance.
- C. Furnish services of manufacturer's technical representative for one (8) hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

END OF SECTION

SECTION 23 81 26 – SPLIT-SYSTEM AIR CONDITIONERS AND HEAT PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Mini-split systems.

B. Related Sections:

1. Section 23 05 48 - Vibration Controls for HVAC Piping and Equipment: Vibration isolators.
2. Section 23 09 23 - Direct-Digital Control System for HVAC: Controls remote from unit.
3. Section 23 21 13 – Condensate Piping
4. Section 23 23 00 - Refrigerant Piping: Execution requirements for connection to refrigerant piping specified by this section.
5. Section 26 05 03 - Equipment Wiring Connections: Electrical connection to units.

1.02 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. AHRI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
2. AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
3. AHRI 340/360 - Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
4. AHRI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.2 – Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM International:

1. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

D. International Association of Plumbing and Mechanical Officials:

1. Uniform Mechanical Code.
2. Uniform Plumbing Code.

- E. International Code Council:
 - 1. International Energy Conservation Code.
 - 2. International Mechanical Code
- F. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
- G. National Fire Protection Association:
 - 1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit data indicating:
 - 1. Cooling and heating capacities.
 - 2. Dimensions.
 - 3. Weights.
 - 4. Rough-in connections and connection requirements.
 - 5. Duct connections.
 - 6. Electrical requirements with electrical characteristics and connection requirements.
 - 7. Controls.
 - 8. Accessories.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of controls installed remotely from units.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.05 QUALITY ASSURANCE

- A. Cooling Capacity: Rate in accordance with AHRI 210/240.
- B. Sound Rating: Measure in accordance with AHRI 270.

- C. Insulation and adhesives: Meet requirements of NFPA 90A.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept units and components onsite in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.08 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of condensing units and heat pumps with concrete pad.
- C. Coordinate installation of air handling units with building structure.

1.09 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five year manufacturers warranty for compressors.

1.10 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

1.11 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Furnish two sets of filters for each unit.

PART 2 PRODUCTS

2.01 MINI-SPLIT SYSTEMS

- A. Acceptable Manufacturers:

- 1. **LG**

2. Mitsubishi.
3. Daikin.
4. Substitutions: Section 01 60 00 - Product Requirements

B. Fan Coil Unit

1. Configuration: Unit shall be wall-mount or ceiling cassette as indicated on the Drawings. All indoor units shall be compatible with associated outdoor units and vice versa.
2. Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, DX cooling coil, air filter, wired for single power connection with control transformer.
 - a. Electric Refrigeration: Refrigerant cooling coil and outdoor package containing compressor, condenser coil and condenser fan.
3. Supply Fan: Line flow fan with multi-speed direct drive motor.
4. Performance:
 - a. Ratings: Seasonal Energy Efficiency Rating (SEER) of the system shall be not less than as indicated on the Drawings.
 - b. Refer to Schedules on Drawings.
5. Operating controls: Units shall be controlled by a factory-installed thermister mounted to the fan-coil unit. A wired remote controller shall control the unit and shall rest in a remote control holder mounted to the fan coil unit.
6. Condensate Pump: Unit shall be provided with condensate pump integral to unit; where integral condensate pump is not offered, a separate condensate pump shall be provided.
 - a. Performance: Pump shall be rated for min. 3 gph discharge at 10 ft. w.g. of head. unless noted otherwise on the Drawings.
 - b. Electrical: Power shall be 120V/1ph unless noted otherwise on the Drawings.
 - c. Accessories: Furnish compatible tubing and self-sealing connector to route to termination as indicated in the Drawings; Contractor shall coordinate to furnish enough tubing length to achieve total length of run as needed. Furnish mounting bracket if pump is required to be mounted separately from indoor unit.

C. Condensing Units / Heat Pump Units

1. Construction and Ratings: In accordance with AHRI 210/240.
2. Compressor: Energy efficient variable speed inverter rotary compressor, resiliently mounted integral with condenser.
3. Air Cooled Condenser: Aluminum fin and copper tube coil, with direct drive axial propeller fan, and fan guard.

4. Provide hail guard accessory for all units. Hail guard shall consist of an anodized aluminum frame around a welded wire mesh screen with UV resistant PVC coating and stainless steel fasteners to all side of unit with exposed coils.
5. Provide wind baffles for all roof-mounted units and other units with limited airflow clearances or where discharge air is directed at an adjacent unit's intake.
6. Refrigerant: Unit shall be pre-charged with refrigerant for minimum of 70 feet of refrigerant piping. Provide additional refrigerant as required for extended lengths of refrigerant lines.
7. Electrical Characteristics: As Scheduled in the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify concrete pad for condensing unit or outdoor heat pump unit is ready for unit installation.
- C. Verify that proper power supply is available for equipment.

3.02 INSTALLATION - AIR HANDLING UNIT

- A. Install in accordance with manufacturer's instructions.
- B. Install components furnished loose for field mounting.
- C. Install connection to electrical power wiring in accordance with Section 26 05 03.

3.03 INSTALLATION – CONDENSING UNIT AND OUTDOOR HEAT PUMP UNIT

- A. Install in accordance with manufacturer's instructions.
- B. Install condensing units and outdoor heat pump units on vibration isolators. Refer to Section 23 05 48.
- C. Install refrigerant piping from unit to condensing unit or outdoor heat pump unit. Install refrigerant specialties specified in Section 23 23 00.
- D. Evacuate refrigerant piping and install initial charge of refrigerant in accordance with ASHRAE 15 and only with unit manufacturer approval.
- E. Install electrical devices furnished loose for field mounting.
- F. Install control wiring between air handling unit, condensing unit, and field installed accessories.
- G. Install connection to electrical power wiring in accordance with Section 26 05 03.

3.04 INSTALLATION – MINI-SPLIT SYSTEM

- A. Install in accordance with manufacturer's instructions.
- B. Provide additional refrigerant charge if installed length of refrigerant piping is longer than manufacturer's allowance for pre-charged system.
- C. Install connection to electrical power wiring in accordance with Section 26 05 03 for all components.
- D. Mount loose condensate pump provided with unit on wall bracket per manufacturer's requirements.

3.05 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Install temporary filters during construction period. Replace with permanent filters at Substantial Completion.

3.06 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment operation and maintenance.

3.07 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.

END OF SECTION

SECTION 23 81 27 - VARIABLE REFRIGERANT FLOW OUTDOOR UNITS (6 TO 30 TONS NOMINAL)

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Variable Refrigerant Flow (VRF) outdoor units (6 to 30 tons Nominal)
2. Heat Recovery Units
3. Rooftop Unit Terminal Device
4. Building Automation System Integration Device

B. Related Sections:

1. Section 23 09 23 – DDC Controls: Controls remote from unit.
2. Section 23 21 13 – Condensate Drain Piping: Execution requirements for connection to condensate drain piping specified by this section.
3. Section 23 23 00 - Refrigerant Piping: Execution requirements for connection to refrigerant piping specified in this section.
4. Section 23 81 28 - Variable Refrigerant Flow Indoor Units: Execution requirements for connection to the outdoor unit specified by this section.
5. Section 26 05 03 – Equipment Wiring Connections: Execution and product requirements for connecting to equipment specified in this section.

1.02 REFERENCES

A. Air-Conditioning, Heating and Refrigeration Institute:

1. AHRI 1230-2010 – Standard for Performance Rating of Variable Refrigerant Flow Multi-Split Air Conditioning and Heat Pump Equipment.

B. ASTM International

1. ASTM Standard D-1418: Standard Practice for Rubber and Rubber Latices—Nomenclature

C. International Code Council:

1. International Energy Conservation Code.

D. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit data indicating:
 1. Cooling and heating capacities.
 2. Dimensions.
 3. Weights.
 4. Rough-in connections and connection requirements.
 5. Electrical requirements with electrical characteristics and connection requirements.
 6. Controls.
 7. Accessories.
 8. Refrigerant piping diagram as specified in section 23 23 00.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of controls installed remotely from units.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.05 QUALITY ASSURANCE

- A. Cooling and Heating Capacity: Rate in accordance with AHRI 1230-2010.
- B. Wiring: In accordance with the National Electrical Code
- C. Insulation and adhesives: Meet requirements of NFPA 90A.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept units and components onsite in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.08 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of units with building structure.

1.09 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish manufacturer's warranty: 2 years for parts and 7 years for compressors.

1.10 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. **LG (Basis of Design)**
- B. Daikin
- C. Mitsubishi (Contractor shall include all modifications to power, condensate drainage, etc. for this system in lieu of basis of design in their bid at no cost to the Owner)
- D. Substitutions: Section 01 60 00 - Product Requirements.

2.02 VARIABLE REFRIGERANT FLOW OUTDOOR UNIT

- A. Unit manufacturer shall be the same manufacturer as the outdoor unit specified in

Section 23 81 27.

- B. Variable Refrigerant Flow (VRF) HVAC system shall be a variable capacity, direct expansion (DX) heat recovery engineered system. The outdoor unit shall consist of one or more cabinet(s) connected through common refrigerant piping. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or combination thereof) through a common refrigerant piping and integrated system controls. Each indoor unit shall be controlled individually.
1. The system shall include multi-port heat recovery units to allow simultaneous heating and cooling of individual zone(s).
- C. Ambient Operating Conditions: Unit shall be capable of operating at the conditions as follows:
1. Cooling: 14 degrees F DB to 122 degrees F
 2. Heating: -13 degrees F WB to 61 degrees F WB
 3. Cooling based synchronous: 14 degrees F DB to 81 degrees F DB
 4. Heating-based synchronous: 14 degrees F WB to 61 degrees F WB
- C. General:
1. The air-conditioning system shall use R410A refrigerant.
 2. Each system shall have one, air source outdoor unit.
 3. Dual- and-triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kit and field provided interconnecting pipe to form a common refrigerant circuit.
 4. Refrigerant circuit configuration for heat recovery system
 - a. The refrigerant circuit shall be constructed using field provided copper piped together with manufacturer supplied heat recovery unit(s) and Y-branches or header fittings connected to multiple (ducted, non-ducted or combination thereof) indoor units to effectively and efficiently control the simultaneous heating and cooling operation of the VRF system.
 - b. Each refrigerant pipe, y-branch, header kit, elbows and valves shall be individually insulated with no air gaps. All joints shall be glued and sealed.
 6. Factory-installed microprocessor controls in the outdoor unit(s), HR unit(s), and indoor unit(s) shall perform functions to efficiently operate the VRF system and communicate in a daisy chain configuration between outdoor unit and HR unit(s) and indoor unit(s) via RS485.
 7. The system shall be capable of performing continuous operation when an individual indoor unit is being serviced or power to indoor unit is disconnected.

9. The maximum allowable system combination ratio of indoor units to an outdoor units on a common refrigerant circuit shall be 130 percent. Systems designed with combination ratio above 130 percent are not acceptable.
10. The total nominal capacity of all indoor units shall be no less than 50 percent and no more than 130 percent of outdoor unit's nominal capacity to ensure the VRF system will have sufficient capacity to meet the building's cooling and heating load at design day weather conditions.
11. The outdoor unit shall have a fusible plug.
12. The fusible plug shall have a threaded connector.
13. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, compressor, contacts, relay(s), power and communications wiring necessary.
14. Each outdoor unit refrigeration circuit shall have the following components:
 - a. Refrigerant strainer(s)
 - b. Check valve(s)
 - c. Oil separator
 - d. Accumulator
 - e. 4-way reversing valve
 - f. Vapor injection valve
 - g. Variable path valve
 - h. Oil balancing valve for Hi-POR (Available for 12 & 14 ton only)
 - i. Oil Level sensor
 - j. Electronic expansion valve(s)
 - k. Sub-cooler
 - l. High and low side Schrader valve service ports with caps.
 - m. Service valves

D. System

1. System shall have a variable flow path heat exchanger function to vary the refrigerant flow path based on system operating mode and operating conditions.
2. System shall have a middle pressure suction gas vapor injection function.
3. System shall have an active refrigerant control function to vary the system refrigerant quantity based on operating mode and operating conditions.
4. System shall have following frame sizes vs. capacity.
 - a. 12 and 14 ton units shall be a single frame only etc.
 - b. 22 and 24 ton units shall be dual frame only etc.
 - c. 30 ton heat recovery units shall be available etc.

E. Refrigerant Pipe System Design Parameters

1. The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively.

2. The outdoor unit shall be capable of operating with up to 3280 equivalent length feet of interconnecting liquid line refrigerant pipe in the network.
3. The outdoor unit shall be capable of operating with up to 656 actual feet or 738 equivalent length feet of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.

F. Defrost Operations

1. The outdoor unit(s) shall be capable of auto defrost operation to melt accumulated frost off the outdoor unit heat exchanger. The defrost cycle control shall be based on outdoor ambient temperatures and outdoor unit heat exchanger temperatures.
 - a. Continuous heating defrost
 - 1) During first two defrost cycles the unit shall allow heating mode indoor unit fans to stay "on" in low speed continuing to heat.
 - b. Complete defrost
 - 1) The third defrost cycle shall switch all outdoor units to defrost mode to fully melt and clear frost, snow or ice accumulations off the outdoor coil while turning "off" heating mode indoor unit fans to maintain efficient performance.

G. Oil Management

1. The system shall have Hi-POR (High Pressure Oil Return) to ensure a consistent film of oil on all moving compressor parts at low speed. Oil is returned to compressor through a separate oil injection pipe.
 - a. Oil return system shall maintain high side pressure return to the compressor.
2. The system shall be provided with a centrifugal oil separator designed to extract oil from the oil/refrigerant gas stream leaving the compressor and return the extracted oil to the compressor oil sump.
3. The system shall have an oil level sensor in the compressor to provide direct oil level sensing.
4. The system shall only initiate an oil return cycle if the oil level is too low.
5. Timed oil return operations or non-oil level sensing systems shall not be permitted.

H. Cabinet

1. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with an enamel finish.
2. Outdoor unit cabinet finish shall be tested in accordance with ASTM B117 salt spray test procedure for a minimum of 1000 hours.

3. The front panels of the outdoor units shall be removable type for access to internal components.
4. A smaller service access panel shall be provided to access the following:
 - a. Service tool connection
 - b. DIP switches
 - c. Auto addressing
 - d. Error codes
5. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front or through the bottom of the unit.

I. Fan Assembly

1. Each 6-ton cabinet shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge.
2. Each 8- to 14-ton cabinet shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge.
3. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material.
4. The fan(s) motor shall be equipped with permanently lubricated bearings.
5. The fan motor shall be variable speed with a maximum operating speed of 1050 RPM.
6. The fan shall have a raised guard to help prevent contact with moving parts.
7. The cabinet shall have option to change the discharge air direction from vertical to horizontal using optional factory provided air guides.
8. The cabinet shall have DIP switch setting to raise external static pressure up to 0.32 inch w.g.

J. Outdoor Unit Coil

1. The outdoor unit shall have a factory-built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubes shall have inner grooves.
3. The aluminum fins shall have factory applied corrosion resistant GoldFin material.
4. Hydrophilic Coil coating shall be tested in accordance with ASTM B117 salt spray test procedure for a minimum of 1000 hours.
5. The outdoor unit coil shall be tested to a pressure of 551 psig.

6. The coil for each cabinet shall have 14 fins per Inch (FPI).
7. All the outdoor units shall have a 3 rows heat exchanger.
8. The cabinet shall have a coil guard.

K. Compressor(s)

1. Each 6-, 8- and 10-ton cabinet shall be equipped with one hermetically sealed, inverter driven, high-side shell (HSS) scroll compressor.
2. The 12- and 14-ton cabinet shall be equipped with two hermetically sealed, inverter driven, HSS controlled scroll compressors.
3. Each inverter driven, HSS scroll compressor shall be capable of operating in a frequency range from 15 Hz to 150 Hz with control in 0.5 Hz increments.
4. The compressor(s) shall be equipped with a 60 Watt crankcase heater.
5. The compressor shall use a factory charge of Polyvinyl Ether (PVE) oil.
6. The compressor bearing(s) shall have Teflon coating.
7. The compressor(s) shall be protected with:
 - a. High Pressure switch
 - b. Over-current /under current protection
 - c. Phase failure
 - d. Phase reversal
8. Standard, non-inverter driven compressors shall not be permitted.

L. Sound Levels

1. Each cabinet shall be rated with a sound level not to exceed 59.5 dB(A) when tested in an anechoic chamber under ISO3745 standard.

M. Sensors

1. Each single cabinet shall have:
 - a. Suction temperature sensor
 - b. Discharge temperature sensor
 - c. High Pressure sensor
 - d. Low Pressure sensor
 - e. Outdoor temperature sensor
 - f. Outdoor unit heat exchanger temperature sensor

2.02 HEAT RECOVERY UNIT (HRB)

A. General

1. HRB unit shall be designed and manufactured by the same manufacturer of VRF indoor unit(s) and outdoor unit(s).

2. HRB unit casing shall be made with galvanized steel.
3. HRB Unit shall be an intermediate refrigerant control device between the air source outdoor unit and the indoor units to control the systems simultaneous cooling and heating operation.
4. HRB unit shall be engineered to work with a three-pipe VRF system comprising:
 - a. High Pressure Vapor Pipe
 - b. Low Pressure Vapor Pipe
 - c. Liquid Pipe
6. HRB unit shall be designed to be piped in series or parallel.
7. HRB unit shall have 2, 3 or 4 ports.
8. Each port shall be capable of operating in cooling or heating independently regardless of the operating mode of any other port on the HRB unit or in the system.
9. Each port shall be capable of connecting from 1 to 8 indoor units to a maximum nominal capacity of 54 MBh.
10. Maximum nominal capacity per HRB unit shall not exceed 192 MBh.
11. Indoor units greater than 54 MBh nominal capacity shall be twinned using a reverse Y-branch.
12. HRB unit shall be internally piped, wired, assembled and run tested at the factory.
13. HRB unit shall be designed for installation in a conditioned environment.
14. HRB unit shall have a liquid bypass valve.
15. HRB unit shall have (2) two-position solenoid valves per port.
16. HRB unit shall have a balancing valve to control the pressure between the high pressure and low pressure pipe during mode switching.
17. HRB unit shall have an electronic expansion valve for subcooling.
18. HRB unit shall not require a condensate drain.
19. HRB unit shall be internally insulated.
20. All field refrigerant lines between outdoor unit and HRB unit and from HRB unit to indoor unit shall be field insulated.
21. The HRB unit shall not exceed a net weight of 49 lbs.
22. The system shall be designed to accommodate 16 HRB units connected to Heat Recovery units piped in single series string.

23. A single series pipe string of 1 to 16 HRB units shall be capable of serving indoor units with a total nominal capacity of 192 MBH per HRB unit.

B. Piping Capabilities

1. The elevation difference between indoor units on heat pump systems shall be 131 feet.
2. The elevation differences for heat recovery systems shall be:
 - a. Heat recovery unit (HRB) to connected indoor unit shall be 49 feet
 - b. HRB to HRB shall be 49 feet
 - c. Indoor unit to indoor unit connected to same HRU shall be 49 feet
 - d. Indoor unit to indoor unit connected to separate parallel HRUs shall be 131 feet.
3. The acceptable elevation difference between two series connected HRB units shall be 16 feet.

C. Controls

1. HRB unit(s) shall have factory installed unit-mounted control boards and integral microprocessor to communicate with other devices in the VRF system.
2. HRB unit shall communicate with the air source unit via the air source/indoor unit 2-conductor shielded communications cable terminated using a daisy chain configuration.
3. The VRF manufacturer shall provide published documentation that specifically allows the installation of field provided isolation valves on all pipes connected to the Heat Recovery unit to allow the servicing of HRB units refrigerant circuit or the replacement of HRB unit without evacuating the balance of the piping system.

2.03 ROOFTOP UNIT TERMINAL DEVICE

- A. Product Description: Self-contained, packaged, factory assembled and wired, consisting of roof curb, cabinet, supply fan, refrigerant components, air filters, and accessories.
- B. Configuration: Downflow air delivery.
- C. Roof Mounting Curb: curb to be provided with equipment; refer to Section 23 05 29 for curb requirements.
- D. Cabinet:
 1. Designed for outdoor installation with weatherproof construction.
 2. Doors: Provide insulated, hinged access doors with quarter-turn handles to access all sections of the air handler.
 3. Panels: Constructed of galvanized steel with baked enamel finish meeting salt

spray test in accordance with ASTM B117. Furnish removable access panels where doors are not provided.

4. Insulation: Factory applied to exposed vertical and horizontal panels. Provide aluminum foil faced glass fiber with edges protected from erosion or closed cell foam, with a minimum total thermal resistance value of R-4.
- E. Supply Fan: Centrifugal type, resiliently mounted with direct drive high efficiency EC motor, as scheduled. Motor permanently lubricated with built-in thermal overload protection.
- F. Refrigeration:
1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
 2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger performance.
 3. Unit shall have a minimum two row coil, 18 fins per inch.
 4. Unit shall have a factory supplied condensate drain pan below the coil.
 5. Unit shall be designed for gravity drain.
 6. Unit shall have provision of 45° flare refrigerant pipe connections.
 7. The coil shall be factory pressure tested at a minimum of 550 psig.
- G. Air Filters: 2 inch thick MERV 8 efficiency based on ASHRAE 52.2.
- H. Controls:
1. Unit shall have a built in control panel with microprocessor control to communicate with other indoor units and to the outdoor unit main processor. It shall perform all functions necessary to operate the system effectively and efficiently and communicate with the other indoor units and outdoor unit over an RS-485 daisy chain. It shall have the following functions:
 - a. Self-diagnostic function
 - b. Auto addressing
 - c. Auto restart function
 - d. Auto changeover function (Heat Recovery system only)
 - e. Auto operation function
 - f. Auto clean function
 - g. Child lock function
 - h. Forced operation
 - i. Dual thermistor control
 - j. Sleep mode
 - k. Dual set point control
 - l. Filter life timer

- m. Power consumption data
 - n. External on/off control input
2. Unit shall be provided with a single set of configurable dry contacts for use with integration with other controls. Unit shall be able to communicate via BACnet to the building automation system.
3. Microprocessor Control:
- a. The microprocessor controller shall be capable of performing functions necessary to operate the system with or without the use of a wall mounted controller. The unit shall have a factory mounted return air thermistor for use as a space temperature control device. All operating parameters except scheduling shall be stored in non-volatile memory resident on the microprocessor. The microprocessor shall provide the following functions, self-diagnostics, auto re-start after a power failure and a test run mode.
 - b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, two core, stranded, twisted and shielded communication cable (RS-485).
 - c. The unit controls shall operate the indoor unit using one of the five operating modes:
 - i. Auto changeover (Heat Recovery System only)
 - ii. Heating
 - iii. Cooling
 - iv. Dry
 - v. Fan only
 - d. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
 - e. The unit shall have adjustable, multi-step cooling and heating mode thermal on/off temperature range settings.
 - f. The system shall include a product check function to access and display indoor unit type and capacity from a programmable thermostat controller.
 - g. Unit shall have a field settable method to choose auto fan speed change operation based on mode of operation, on/off fan operation based on mode of operation, or continuous minimum set fan speed operation.

4. Wired Remote Controller (wall mounted)
 - a. Where indicated on the drawings provide a wired remote controller for each indoor unit or group of units, (see plan drawing for units grouped to a common controller).
 - i. Controller shall be LG model PREMTBVC0 or equal with white finish.
 - b. Controller shall communicate with each unit's on board microprocessor controller and shall be capable of the following functions.
 - i. Temperature setting adjustment
 - ii. Afterhours override
 - iii. All other functions shall be password protected.
 - c. Dimensions WxHxD (in.): 3.39x4.72x1.06

5. Remote Space Temperature Sensor (wall mounted)
 - a. Where indicated on the drawings provide a wired remote space temperature sensor for each indoor unit .
 - i. Sensor shall be an LG model ZRTBS01 or equal.
 - b. Sensor shall be wired to the indoor unit and used in lieu of the indoor unit's return air thermister for controlling the space temperature.

I. Capacity: See Schedule on Drawings.

J. Electrical Characteristics and Components: In accordance with Section 26 05 03 and as scheduled.

1. Disconnect Switch: Factory mounted, non-fused type, interlocked with access door, accessible from outside unit, with power lockout capability.
2. Electrical Connection: The unit shall have capability of single point power supply connection from below, up through the roof level.

2.04 COMMUNICATION MANAGER DEVICE

A. The Communication Manager Device shall provide energy management and be capable of integrating with a third party BACnet Building Automation System. The device shall be capable of providing daily, weekly, yearly and holiday programming scheduling of Occupied/Unoccupied settings, On/Off, Mode of Operation, set point and fan speed.

1. The device shall be an LG model PBACNBTRA0A or equal.

B. Device Data:

1. Dimensions WxHxD (in.): 7.05x4.33x 2.4
 2. Removable micro-SD card with 4GB flash total storage/2 GB user storage
 3. Two isolated V-Net communication ports.
 4. Two 10/100 MB Ethernet Ports.
 5. Power Supply: 24VAC/24VDC
 6. Power Consumption: 24 VA
 7. Shall communicate to the VRF indoor units via the VRF RS-485 daisy chain communication protocol.
- C. Graphical User Interface with:
1. Indoor unit control/monitoring by groups/indoor units
 2. Operation – on/off
 3. Mode – Auto/low/med/high/power
 4. Two setpoint auto-changeover
 5. Occupancy control
 6. Speed, controller lock and louver swing
 7. Temperature setpoint range limit.
 8. Remote controller lockout (All, Setpoint, Mode, Fan Speed)
 9. Power distribution indicator.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify curb rails for outdoor heat pump unit are ready for unit installation.
- C. Verify that proper power supply is available for equipment.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

- B. Install refrigerant piping as specified in Section 23 23 00.
- C. Evacuate refrigerant piping and install initial charge of refrigerant in accordance with ASHRAE 15 and only with manufacturer approval.
- D. All refrigerant levels in the VRF system shall have manufacturer's approval.
- E. Install electrical devices furnished loose for field mounting.
- F. Install control wiring between indoor units, outdoor units, and field installed accessories.
- G. Install connection to electrical power wiring in accordance with Section 26 05 03.
- H. Provide manufacturer's field start-up services and coordinate with controls and BAS.
- I. Coordinate Start/Stop schedule with BAS contractor and Owner.

3.04 INSTALLATION – VRF (HEAT RECOVERY SYSTEM)

- A. Install in accordance with manufacturer's instructions.
- B. Install VRF heat pumps on vibration isolator curbs as specified in Section 23 05 29.
- C. Install connection to electrical power wiring in accordance with Section 26 05 03.
- D. Provide manufacturers field start-up services and coordinate with controls and BAS.
- E. Coordinate Start/Stop schedule with owner.

3.05 INSTALLATION – HEAT RECOVERY BOXES

- A. Install in accordance with manufacturer's instructions.
- B. Install connection to electrical power wiring in accordance with Section 26 05 03.
- C. Provide manufacturers field start-up services and coordinate with controls and BAS.
- D. Coordinate Start/Stop schedule with owner.

3.06 INSTALLATION – ROOFTOP TERMINAL UNIT

- A. Roof Curb:
 - 1. Assemble roof curb.
 - 2. Install roof curb level.
 - 3. Coordinate curb installation and flashing with specified roofing system.
 - 4. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
 - 5. Install gasket material between unit base and roof curb.
- B. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.

- C. Install condensate piping with trap and route from drain pan as shown on Drawings. Refer to Section 23 05 29 for supports.
- D. Install components furnished loose for field mounting.
- E. Install electrical devices furnished loose for field mounting.
- F. Install control wiring between unit and field installed accessories.
- G. Any panels permanently removed from units during installation shall be removed from roof and dispose off-site.

3.07 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Vacuum clean coils and inside of unit cabinet.

3.08 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment operation and maintenance.

3.09 MANUFACTURER STARTUP SERVICE

- A. Manufacturer's Field Service: Factory trained competent technicians skilled in the setting and adjustment of VRF equipment shall inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
- B. Controls Integration into BAS: VRF Manufacturer's factory trained controls technician skilled in integrating VRF controls with a 3rd party BAS shall work jointly with the controls contractor to integrate the VRF controls into the new facility's BAS.
 - 1. Refer to section 23 81 28 - Variable Refrigerant Flow Indoor Units for controls specified there.
 - 2. Refer to section 23 09 23 – DDC controls for controls specified there related to the integration of the VRF controls with the BAS.
 - 3. Refer to the controls Drawings for requirements specified there.
- C. Attend and demonstrate the VRF system controls in conjunction with the controls demonstration specified in section 23 09 00.

3.10 TRAINING

- A. Provide a minimum of 8 hours of instruction to Owner's personnel in two four sessions in the operation and maintenance of the system, indoor units, outdoor units, accessories and controls. Provide training after the system has been installed and checked out and commissioning is complete.

3.11 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not operate air handling units until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

3.12 SCHEDULES

- A. See Drawings.

END OF SECTION

SECTION 23 81 28 - VARIABLE REFRIGERANT FLOW INDOOR UNITS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Variable Refrigerant Flow (VRF) indoor units (5k to 96k BTUH Nominal)

B. Related Sections:

1. Section 23 09 23 – DDC Controls: Controls remote from unit.
2. Section 23 21 13 – Condensate Drain Piping: Execution requirements for connection to condensate drain piping specified by this section.
3. Section 23 23 00 - Refrigerant Piping: Execution requirements for connection to refrigerant piping specified in this section.
4. Section 23 81 27 - Variable Refrigerant Flow Outdoor Units: Execution requirements for connection to the outdoor unit specified by this section.
5. Section 26 05 03 – Equipment Wiring Connections: Execution and product requirements for connecting to equipment specified in this section.

1.02 REFERENCES

A. Air-Conditioning, Heating and Refrigeration Institute:

1. AHRI 1230-2010 – Standard for Performance Rating of Variable Refrigerant Flow Multi-Split Air Conditioning and Heat Pump Equipment.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. ASTM International

1. ASTM Standard D-1418: Standard Practice for Rubber and Rubber Latices—Nomenclature

D. International Code Council:

1. International Energy Conservation Code.
2. International Mechanical Code

E. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating

Systems.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit data indicating:
 - 1. Cooling and heating capacities.
 - 2. Dimensions.
 - 3. Weights.
 - 4. Rough-in connections and connection requirements.
 - 5. Duct connections.
 - 6. Electrical requirements with electrical characteristics and connection requirements.
 - 7. Controls.
 - 8. Accessories.
- C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of controls installed remotely from units.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.05 QUALITY ASSURANCE

- A. Cooling and Heating Capacity: Rate in accordance with AHRI 1230-2010.
- B. Wiring: In accordance with the National Electrical Code
- C. Insulation and adhesives: Meet requirements of NFPA 90A.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept units and components onsite in factory protective containers, with factory shipping skids and lifting lugs. Inspect for damage.
- C. Comply with manufacturer's installation instruction for rigging, unloading and transporting units.
- D. Protect units from weather and construction traffic by storing in dry, roofed location.

1.08 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of units with building structure.

1.09 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.

1.10 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. **LG (Basis of Design)**
- B. Daikin
- C. Mitsubishi (Contractor shall include all modifications to power, condensate drainage, etc. for this system in lieu of basis of design in their bid at no cost to the Owner)
- D. Substitutions: Section 01 60 00 - Product Requirements.

2.02 GENERAL

- A. Unit manufacturer shall be the same manufacturer as the outdoor unit specified in Section 23 81 27.
- B. Units shall be available as ducted, ductless or a combination of both, and shall be complete with factory mounted controls, fans, coils, electronic expansion valves , condensate drain pans, filter racks and wiring terminal blocks.

2.03 INDOOR UNIT TYPES

A. The following unit types shall be available:

1. Wall Mount
2. Ceiling Cassette – 4 Way
3. Ducted – High Static

2.03 REQUIREMENTS (Applicable to all Indoor Unit Types)

A. The following are applicable to all unit types, unless noted otherwise. Refer to the individual articles herein specified for requirements specified there which are unique to a particular type indoor unit.

B. Cabinet Assembly:

1. Unit shall be equipped with factory installed temperature thermistors for:
 - a. Return air
 - b. Refrigerant entering coil
 - c. Refrigerant leaving coil
2. Unit shall be equipped with factory installed temperature thermistors for:
 - a. Return air
 - b. Refrigerant entering coil
 - c. Refrigerant leaving coil
3. Unit shall have a factory assembled, piped and wired electronic expansion valve for refrigerant control.
3. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit main processor.

D. Fan Assembly:

1. The unit shall have direct driven fan(s) made of high strength ABS polymeric resin.
2. The fan impeller shall be statically and dynamically balanced.
3. The fan motor shall be brushless digitally commutated with permanently lubricated and sealed ball bearings.
4. The fan motor shall include thermal, over current and low RPM protection.
5. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
6. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm that provides a minimum of three pre-programmed fan speeds in the heating mode and fan only mode and four speeds in the cooling mode. The fan speed algorithm provides a field

selectable fixed speed.

7. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Power Cool, and Auto
8. In heating mode, the indoor fan shall have the following settings: Low, Med, High, and Auto.

F. Coil Assembly:

1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger performance.
3. Unit shall have a minimum two row coil, 18 fins per inch.
4. Unit shall have a factory supplied condensate drain pan below the coil constructed of EPS (coated expandable polystyrene resin).
5. Unit shall be designed for gravity drain.
6. Unit shall have a 5/8" inside diameter factory insulated drain hose to handle condensate.
7. Unit shall have provision of 45° flare refrigerant pipe connections.
8. The coil shall be factory pressure tested at a minimum of 550 psig.
9. Except for Ducted Vertical/Horizontal Air Handler and Floor Standing Type, unit shall include a factory installed and wired condensate drain lift pump capable of providing minimum 27.5 inch lift from bottom surface of the unit. Complete with safety switch to shutdown unit upon sensing an overflow condition.

D. Electrical:

1. The unit electrical power characteristics shall be as scheduled on the drawings.
2. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

I. Controls:

1. Unit shall have a built in control panel with microprocessor control to communicate with other indoor units and to the outdoor unit main processor. It shall perform all functions necessary to operate the system effectively and efficiently and communicate with the other indoor units and outdoor unit over an RS-485 daisy chain. It shall have the following functions:

- a. Self-diagnostic function
 - b. Auto addressing
 - c. Auto restart function
 - d. Auto changeover function (Heat Recovery system only)
 - e. Auto operation function
 - f. Auto clean function
 - g. Child lock function
 - h. Forced operation
 - i. Dual thermistor control
 - j. Sleep mode
 - k. Dual set point control
 - l. Filter life timer
 - m. Power consumption data
 - n. External on/off control input
2. Unit shall be provided with a single set of configurable dry contacts for use with integration with other controls. Unit shall be able to communicate via BACnet to the building automation system.
3. Microprocessor Control:
- a. The microprocessor controller shall be capable of performing functions necessary to operate the system with or without the use of a wall mounted controller. The unit shall have a factory mounted return air thermistor for use as a space temperature control device. All operating parameters except scheduling shall be stored in non-volatile memory resident on the microprocessor. The microprocessor shall provide the following functions, self-diagnostics, auto re-start after a power failure and a test run mode.
 - b. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, two core, stranded, twisted and shielded communication cable (RS-485).
 - c. The unit controls shall operate the indoor unit using one of the five operating modes:
 - b. Auto changeover (Heat Recovery System only)
 - c. Heating
 - d. Cooling
 - e. Dry
 - f. Fan only
 - a. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
 - b. The unit shall have adjustable, multi-step cooling and heating mode thermal on/off temperature range settings.
 - c. The system shall include a product check function to access and display indoor unit type and capacity from a programmable

- thermostat controller.
- d. Unit shall have a field settable method to choose auto fan speed change operation based on mode of operation, on/off fan operation based on mode of operation, or continuous minimum set fan speed operation.
4. Wired Remote Controller (wall mounted)
- a. Where indicated on the drawings provide a wired remote controller for each indoor unit or group of units, (see plan drawing for units grouped to a common controller).
 - i. Controller shall be LG model PREMTBVC0 or equal with white finish.
 - b. Controller shall communicate with each unit's on board microprocessor controller and shall be capable of the following functions.
 - i. Temperature setting adjustment
 - ii. Afterhours override
 - iii. All other functions shall be password protected.
 - c. Dimensions WxHxD (in.): 3.39x4.72x1.06
5. Remote Space Temperature Sensor (wall mounted)
- a. Where indicated on the drawings provide a wired remote space temperature sensor for each indoor unit .
 - i. Sensor shall be an LG model ZRTBS01 or equal.
 - b. Sensor shall be wired to the indoor unit and used in lieu of the indoor unit's return air thermistor for controlling the space temperature.

2.04 REQUIREMENTS (Specific to type of Indoor Unit)

A. Wall Mount Type

- 1. Designed for mounting on a vertical surface in the space it serves.
- 2. Casing/Panel:
 - d. Constructed of Acrylonitrile Butadiene Styrene (ABS) polymeric resin with a neutral color finish.
 - e. Designed for mounting on a vertical surface and furnished with an installation mounting template, guild and separate hanging bracket.
- 3. Filter Assembly:
 - a. Return air inlet shall have a factory supplied removable, washable filter
 - b. Filter access shall be from the front of the unit without the need

of tools.

4. Air Distribution:
 - a. Unit shall have one supply air outlet and one return air inlet.
 - b. Provide with motorized louver to distribute the flow of air in up and down direction for uniform airflow.
 - c. Provide with motorized guide vane to control the direction of air flow from side to side.

B. Cassette 4- Way Type

1. Designed for mounting recessed in the ceiling with a surface mounted grille with air inlet and outlet(s).
2. Casing/Panel:
 - a. Case constructed of galvanized steel plate with corner brackets with pre-punched holes for supporting unit with all thread rod hangers.
 - b. Grille constructed of Acrylonitrile Butadiene Styrene (ABS) polymeric resin with an off-white finish.
 - c. The grille shall have a hinged, spring clip return air filter-grille door
2. Filter Assembly:
 - a. Return air inlet shall have a factory supplied removable, washable filter.
 - b. Filter access shall be from the bottom of the unit without the need of tools.
3. Air Distribution:
 - a. **4-Way Type:**
 - i. Unit shall have four supply air outlets and one return air inlet.
 - ii. The supply air outlets shall have four directional slot diffusers each with oscillating motorized guide vanes designed to change the airflow direction.
 - iii. The grille shall have a discharge range of motion of 40° in an up/down direction with capabilities of locking the vanes.
 - iv. The unit shall have a guide vane algorithm designed to sequentially change the predominant discharge airflow direction in counterclockwise pattern.
 - v. Guide vanes shall provide airflow in all directions.
 - vi. The unit shall be provided with a knockout for outside air.
 - vii. The unit shall be provided with knockouts for branch supply air.

C. Ducted High Static Type

1. Designed for mounting concealed above the ceiling.

2. Casing/Panel:
 - a. Unit case shall be manufactured using galvanized steel plate.
 - b. The cold surfaces of the unit shall be covered internally with a coated polystyrene insulating material.
 - c. The cold surfaces of the unit shall be covered externally with sheet insulation made of Ethylene Propylene Diene Monomer (M-Class) (EPDM)
 - d. The external insulation shall be plenum rated and conform to ASTM Standard D-1418.
 - e. Unit shall be provided with hanger brackets designed to support the unit weight on four corners.
 - f. Hanger brackets shall have pre-punched holes designed to accept field supplied, all thread rod hangers.

2. Filter Assembly:
 - a. Except where indicated otherwise on the drawings, the return air inlet shall have a factory supplied removable, washable filter.
 - b. The filter access shall be from the rear of the unit.

3. Air Distribution:
 - a. Unit shall have horizontal supply air discharge outlets and a return air inlet.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- C. Examine roughing-in of refrigerant and condensate drainage piping systems and electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.
- E. Verify ductwork is ready for unit installation.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Connect to ductwork in accordance with Section 23 31 00.
- C. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.
- D. Protection: Provide finished cabinet units with protective covers during balance of construction.

- E. Install refrigerant piping from unit to condensing unit. Install refrigerant specialties, as required by the unit manufacturer.
- F. Refrigerant piping shall be pressure tested in the field with dry nitrogen to a pressure as required by the unit manufacturer.
- G. Evacuate refrigerant piping and install initial charge of refrigerant in accordance with ASHRAE 15.
- E. Each hot gas, suction and liquid refrigerant line shall be insulated.
- I. Install electrical devices furnished loose for field mounting.
- J. Install connection to electrical power wiring in accordance with Section 26 05 03.
- K. Install control wiring between VRF indoor unit, VRF outdoor unit, and field installed accessories.

3.03 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 specifications. Drawings indicate general arrangement of piping, fittings and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect condensate drain pans, to drainage piping.
- D. Wire field installed condensate overflow safety switches to shutdown unit in an overflow event.
- E. Duct installation and connection requirements are specified in other Division 23 specifications. Drawings indicate general arrangement of ducts and duct accessories.
- F. Electrical: Comply with applicable requirements in Division 26 for power wiring, switches and motor controls.
- G. Ground equipment according to Division 26.
- H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.04 MANUFACTURER STARTUP SERVICE

- A. Manufacturer's Field Service: Factory trained competent technicians skilled in the setting and adjustment of VRF equipment shall inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new

units, and retest.

- B. Controls Integration into EMCS: VRF Manufacturer's factory trained controls technician skilled in integrating VRF controls with a 3rd party EMCS shall work jointly with the Energy Management Control System's technician to integrate the VRF controls into the existing campus EMCS.
 - 1. Refer to section 23 81 27 - Variable Refrigerant Flow Outdoor Units for controls specified there.
 - 2. Refer to section 23 09 23 – DDC controls for controls specified there related to the integration of the VRF controls with the BAS.
 - 3. Refer to the controls drawings for requirements specified there.

3.05 CLEANING

- A. After construction is completed, including painting, clean exposed surfaces of units.
- B. Clean low profile fan coil units internally, on completion of installation, according to manufacturer's written instructions. Clean fan interiors to remove foreign material and construction dirt and dust. Vacuum clean fan wheels, cabinets, and coils entering air face.
- C. After completing system installation and testing, adjusting, and balancing of the air-distribution systems, clean filter housings and install new filters.
- D. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

3.06 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment operation and maintenance.

3.07 SCHEDULES

- A. See Drawings.

END OF SECTION

SECTION 26 00 01 – BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Basic Electrical Requirements specifically applicable to all Division 26 Sections, in addition to Division 1 - General Requirements.

1.02 OWNER-FURNISHED PRODUCTS

- A. Products furnished to the site and paid for by Owner:
 - 1. Where indicated on the Drawings or other sections of the specifications.

1.03 WORK SEQUENCE

- A. Install work in sequence to accommodate Owner's occupancy requirements during the construction period. Coordinate schedule and operations with Architect/Engineer and Owner.

1.04 BASIS OF BID

- A. The Bidders shall bid the work on the basis of the design presented on the Drawings and in the specifications. If in the opinion of the Bidder, the design will not be acceptable to the authorities having jurisdiction, he shall notify the Architect/Engineer, in writing, at least ten days prior to bid opening. After receipt of notice, and concurrence by the Architect/Engineer, changes to the design will be issued by addendum to all bidders of record.

1.05 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code, current edition with local amendments, if any.
- B. Applicable Building Code.
- C. All work installed under this contract shall comply with the requirements of the referenced standards.
- D. All materials and labor furnished by the Contractor shall be in strict accordance with the rules and requirements of the National Board of Fire Underwriters, NEC, State and Municipal regulations, telephone company, power company and other authorities who may have lawful jurisdiction over the work being done.

1.06 SUBMITTALS

- A. Submit under provisions of Section 01 33 00 – Submittal Procedures.
- B. Submit Shop Drawings and product data grouped to include complete submittals of

related systems, products and accessories in a single submittal.

- C. Mark dimensions and values in units to match those specified. Include wiring diagrams of electrically powered equipment.

1.07 REGULATORY REQUIREMENTS

- A. Conform to referenced codes.
- B. Obtain permits, and obtain all required inspections from authority having jurisdiction.
- C. The Contractor will be responsible for all permits and inspections required by law for the completion of his work. Cost of all permits and inspections shall be paid by the Contractor. The Contractor shall obtain and pay for all certificates of approval which must be delivered to the Architect before final acceptance of the job.
- D. All Division 26 work shall be done under the supervision of a currently licensed State of Texas Master Electrician.

1.08 PROJECT/SITE CONDITIONS

- A. Contractor shall visit the site prior to bid and carefully familiarize himself with all existing conditions as may be determined by visual inspection without removing permanent finishes. If discrepancies are noted between the Drawings and existing conditions, the contractor shall notify the Architect/Engineer, in writing, no later than ten days prior to bid opening of the discrepancies. Upon receipt of notice of discrepancies, and verification, the Architect/Engineer will issue corrections by addendum to all bidders of record.
- B. Prepare Drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections.

1.09 QUALITY ASSURANCE

- A. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings or engineering parameters from those indicated on the contract documents, the contractor shall be responsible for all costs, including costs of all trades affected, involved in integrating the equipment or accessories into the system and the assigned space and for obtaining the performance from the system into which these items are placed.
- B. All materials, except medium voltage equipment and components, shall be listed by and shall bear the label of an approved electrical testing laboratory. If none of the approved electrical testing laboratories has published standards for a particular item, then other national independent testing standards, if available, applicable and approved by Architect/Engineer, shall apply and such items shall bear those labels.

1.10 INTENT

- A. The Contractor shall furnish and install all the necessary materials, apparatus, and devices to complete the electrical equipment and systems installation herein specified, except such parts as are specifically exempted herein.

- B. If an item is either called for in the specifications or shown on the plans, it shall be considered sufficient for the inclusion of said item in this contract. If a conflict exists within the Specifications or exists within the Drawings, the Contractor shall furnish the item, system, or workmanship, which is the highest quality, largest, or most closely fits the Architect/Engineer's intent (as determined by the Architect/Engineer Project Manager).
- C. The details and Drawings are diagrammatic. The Contractor shall verify all dimensions at the site and be responsible for their accuracy.
- D. All sizes as given are minimum except as noted.
- E. Whenever a particular manufacturer's specific product is named, it is intended to establish a level of quality and performance requirements.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.01 SCOPE

The accompanying Plans and Specifications as outlined in the various sections of this Division cover the furnishing of all labor, materials, tools, transportation services, etc., necessary for complete and working installation of electrical facilities.

3.02 FIRESTOPPING

- A. Unless specifically indicated otherwise on the Drawings, all penetrations of fire-rated walls and floors shall be made in accordance with specification Section 07 84 00.

3.03 TESTING

- A. General: Provide all labor, materials and equipment necessary to make the required tests as required by code or per other Division 26 sections.

3.04 EXCAVATION AND BACKFILL

- A. Perform all excavation and backfill work to accomplish indicated electrical systems installation in accordance with provisions of Division 31. Blasting will not be allowed without written permission of the Architect/Engineer and Owner.

3.05 CONCRETE WORK

- A. All cast-in-place concrete unless noted otherwise elsewhere will be provided under Division 3. Provide all Layout Drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for the support of electrical equipment.

3.06 BUILDING ACCESS

- A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.07 EQUIPMENT ACCESS

- A. Install all piping, conduit, ductwork and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster or drywall walls or ceilings, provide the access doors.

3.08 COORDINATION

- A. Cooperate with other trades and Architect/Engineer's personnel in locating work. Should it be necessary to raise or lower or move longitudinally any part of the electrical work to better fit the general installation, such work shall be done at no extra cost to the Project. The Contractor shall check location of electrical outlets with respect to other installations before installing.
- B. The Contractor shall verify that all devices are compatible for the surfaces in or on which they will be used. This includes, but is not limited to light fixtures, panelboards, devices, etc. and recessed or semi-recessed heating units installed in/on architectural surfaces.
- C. Coordinate all work with other trades prior to installation. Any installed work that is not coordinated and that interferes with other trades' work shall be removed without additional cost.

3.09 SLEEVES

- A. Pipe sleeves for conduits 6" in diameter and smaller, in new poured concrete construction, shall be schedule 40 steel pipe, plastic removable sleeve or sheet metal sleeve, all cast in place.
- B. In wet area floor penetrations, provide Schedule 40 sleeves only. Top of sleeve to be 2 inches above the adjacent floor. Wet areas for this paragraph are rooms or spaces containing air handling unit coils, converters, pumps, chillers, boilers and similar waterside equipment.

3.10 HOUSEKEEPING AND CLEANUP

- A. The Contractor shall clean up and remove from the premises, on a daily basis, all debris and rubbish resulting from its work and shall repair all damage to new and existing equipment resulting from its work. When job is complete, this Contractor shall remove all tools, excess material and equipment, etc., from the site.

END OF SECTION

SECTION 26 05 03 – EQUIPMENT WIRING CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. The work under this section includes electrical connections to equipment specified under other Divisions and/or Sections, or furnished by Owner, including, but not limited to:
 - 1. HVAC motors and panels.
 - 2. Plumbing motors and panels.
- B. Related Sections:
 - 1. Section 26 05 19 - Building Wire and Cable.
 - 2. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations and construction.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Submittal procedures.
- B. Project Record Documents: Record actual locations, sizes and configurations of equipment connections.

1.05 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.

- E. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 PRODUCTS

2.01 CORD AND PLUGS

- A. Attachment Plug Construction: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6; match receptacle configuration with outlet furnished for equipment.
- C. Cord Construction: Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

2.02 RACEWAYS, BUILDING WIRE AND CABLE, AND ENCLOSED SWITCHES

- A. As specified in other Division 26 sections.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify equipment is ready for electrical connection, for wiring and to be energized.

3.02 INSTALLATION

- A. Make electrical connections. Utilize cord, receptacles and attachment plugs for portable equipment or for any equipment furnished by manufacturer with cord and plug connections. Install receptacle outlet to accommodate connection with attachment plug. Install cord and cap for field-supplied attachment plug. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes. Provide wire basket type strain reliefs, both ends for any suspended cords. Connect all other equipment with raceways and provide suitably rated disconnecting means, capable of being locked in the "off" position.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- E. Install terminal block jumpers to complete equipment wiring requirements.

- F. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements. Install in accordance with equipment vendor's requirements.
- G. HVAC and Plumbing Connections:
 - 1. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters, variable frequency drives (VFDs), and disconnects to motors or to packaged control panels. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.
 - 2. Provide 120 volts to each temperature control panel. Coordinate requirements with HVAC/DDC contractors.
 - 3. Provide 120 volts to each condensate and circulation pump. Coordinate requirements with HVAC/plumbing contractors.
 - 4. Unless otherwise specified, all control devices such as aquastats, float and pressure switches, fan-powered VAV boxes, switches, electro-pneumatic switches, solenoid valves and damper motors requiring mechanical connections shall be furnished and installed and wired under other divisions of these specifications.
 - 5. Each motor terminal box shall be connected with a minimum 12", maximum 36" piece of flexible PVC-coated metal conduit to a fixed junction box. Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.
 - 6. Check for proper rotation of each motor.

3.03 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

3.04 EQUIPMENT TO BE CONNECTED

- A. Unless specifically noted otherwise, each piece of utilization equipment shown on the Drawings, whether Owner furnished or Contractor furnished, shall be connected by the Contractor.

END OF SECTION

SECTION 26 05 19 – 600-VOLT BUILDING WIRE AND CABLE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes building wire; and wiring connectors and connections.

1.02 REFERENCES

- A. NFPA 70 – National Electrical Code

1.03 SYSTEM DESCRIPTION

- A. Conductors intended for power wiring and control wiring operating at above 50 volts to 600 volts nominal. Section includes both individual conductors and cable assemblies.

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit for building wire and each cable assembly type.

1.05 QUALIFICATIONS

- A. Manufacturer: Company supplying products listed by UL or CSA.

PART 2 PRODUCTS

2.01 GENERAL

- A. All conductors shall be copper unless specifically noted or otherwise allowed in specifications or on Drawings. Conductor sizing shown on plans and schedules is based on copper unless specifically noted otherwise.
- B. All conductors shall be new, delivered to site in unbroken original packaging out of manufacturer's stock.

2.02 CONDUCTORS

- A. Conductor: Copper in sizes #14 and larger.
 - 1. #14 AWG and larger for control circuits.
 - 2. #12 AWG and larger for power and lighting circuits.
 - 3. All control wiring and motor connections shall utilize stranded conductors.
 - 4. Use stranded conductors for all feeders and branch circuits #10 AWG and larger.

- B. Terminations:
1. Split Bolt Connectors: Not Acceptable.
 2. Solderless Pressure Connectors: High copper alloy terminal. May be used only for conductor terminations to equipment pads or terminals. Not approved for splicing.
 - a. 3M
 - b. Ideal
 - c. T & B
 - d. Substitutions: Section 01 60 00 - Product Requirements.
 3. Spring Wire Connectors: Solderless spring type pressure connector with insulating covers for copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
 - a. Buchanan
 - b. Ideal
 - c. T & B
 - d. Substitutions: Section 01 60 00 - Product Requirements.
 4. Compression (Crimp) Connectors: Long barrel; seamless, with internally beveled barrel ends. Connector shall be dual rated (AL7CU or AL9CU) and Listed by UL for use with copper conductors, and sized to accept conductors of the required ampacity. Connectors shall be marked with wire size, die index, number and location of crimps and shall be suitably color-coded. Using a suitable stripping tool, remove insulation from the required length of the conductor. Crimp the connection per the connector manufacturer's recommendation.
 - a. Burndy
 - b. T & B
 - c. Substitutions: Section 01 60 00 - Product Requirements.
 5. Mechanical Connectors: For use on copper conductors only. Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances, unless otherwise noted specifically on plans.
 - a. Burndy
 - b. IlSCO
 - c. T & B
 - d. Substitutions: Section 01 60 00 - Product Requirements.
 6. When terminating conductors to plated bus, prepare a compression-type connection. Bolts shall be plated or galvanized medium carbon steel; heat treated, quenched and tempered equal to current ASTM standard or SAE grade 5. Nuts shall conform to current ANSI standards. Washers shall be steel, Type A plain, standard wide series conforming to current ANSI standards. Belleville conical spring washers shall be of hardened steel, cadmium plated or silicone bronze. Lubricate and tighten the hardware per manufacturer's recommendations.
 7. Underground Connectors: All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

2.03 BUILDING WIRE

- A. Product Description: Single conductor insulated wire.
- B. Insulation Types and Permitted Uses:
 - 1. Type THHN/THWN, XHHW for all interior copper branch circuits and feeders.
 - 2. Type XHHW-2 for all exterior conductors.

2.04 WIRE COLOR

- A. General
 - 1. Provide color coding in accordance with local code or Owner's established requirements. If not governed by local code requirements, verify with Owner if any special requirements apply. If not, provide colors as follows:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Orange color reserved for high leg of 120/240V delta systems.
 - c. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - d. Purple, brown, and yellow for circuits at 277/480 volts single or three phase.
 - e. Neutral Conductors: 120/240V and 120/208V systems, White; 277/480V systems, Gray.
 - f. Ground Conductors: Green. Isolated ground conductors: green with yellow trace.
 - 2. For wire sizes 10 AWG and smaller, install wire with insulation colors in accordance with the above.
 - 3. For wire sizes 8 AWG and larger, provide insulation colors as above or identify wire with colored tape at terminals, splices and boxes.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit numbers.
- C. Branch Circuit Conductors: Install multi-wire circuits with each phase uniquely color coded.

2.05 MISCELLANEOUS ACCESSORY MATERIALS

- A. Conductor Phase Marking Tape:
 - 1. Furnish materials in accordance with referenced standards and authority having jurisdiction.
 - 2. Tape: Colored adhesive tape, equal to 3M Type 35.
- B. Wire Markers
 - 1. Furnish materials in accordance with referenced standards and authority having jurisdiction.

2. Description: Split sleeve type wire markers.
3. Legend:
 - a. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.
- C. Cable Pulling Lubricant
 1. Products: Ideal 'Yellow 77+' or equal

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.
- E. Verify field measurements are as indicated on Drawings.

3.02 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required to meet project conditions.
- B. Wire and cable routing is approximate unless dimensioned.

3.03 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, and as specified.

3.04 INSTALLATION

- A. All wiring shall be installed as individual conductors contained in raceway systems,

unless specifically noted otherwise on the Drawings or otherwise specified. Cables are not raceways.

- B. Provide separate neutral conductors for all single phase circuits. The use of multi-wire circuits with common neutrals is not allowed.
- C. Neatly train and lace wiring inside boxes, equipment and panelboards.
- D. Provide minimum 10 AWG conductors for 20 ampere, 120 volt branch circuit home runs longer than 75 feet.
- E. Provide minimum 10 AWG conductors for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
- F. Special Techniques – Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 1/0 AWG and larger with motorized pulling equipment.
 - 3. Use Listed wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary.
 - 4. Place all conductors of a given circuit in the same raceway. This includes phase wires, neutral (if any), and ground conductor. If parallel phase and/or neutral wires are used, place an equal number of phase and neutral conductors in same raceway.
 - 5. Maintain equal lengths on all parallel conductors.
 - 6. Completely and thoroughly swab raceway before installing wire.
- G. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Split bolt connectors are unacceptable for any purpose. Listed compression type connectors installed with compatible tooling may be used. Utilize manufacturer's preformed insulating devices when available and listed for use with installed connection.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

- H. Do not place stranded conductors directly under wiring device screws.
- I. Conductor Phase Marking Tape:
 - 1. Install to identify phasing on all conductors #8 and larger, at each termination and in junction boxes, gutters and pull boxes.
- J. Wire Marker Installation:
 - 1. Install wire marker for each conductor at equipment cabinets, pull boxes, outlet and junction boxes.

3.05 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Provide visual and mechanical inspections on all conductors 1/0 AWG and larger as follows:
 - 1. Inspect exposed sections for physical damage.
 - 2. Verify cable is supplied and connected in accordance with single line diagram.
 - 3. If cables are terminated through window-type CTs, make an inspection to verify that neutrals and grounds are properly terminated for normal operation of protective devices.
 - 4. Inspect for visual jacket and insulation condition.
 - 5. There shall be NO tests performed on existing cable without specific direction from the Engineer.
 - 6. Visually inspect cables, lugs, connectors and all other components for physical damage and proper connections.
 - 7. Check all cable connectors for tightness (with a torque wrench) and clearances. Torque test conductor and bus terminations to manufacturer's recommendations.
- C. Provide electrical tests on conductors as follows:
 - 1. All secondary conductors from the utility transformers to service equipment and all phase conductors 1/0 and larger shall be subjected to insulation tests using a 500 vdc megger.
 - 2. Check for proper grounding resistance at all services and at transformers. Resistance shall be 2 ohms maximum.
- D. Test results and report shall be provided to the engineer.
- E. Contractor shall correct all deficiencies reported in the test report.

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END OF SECTION

SECTION 26 05 26 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Rod electrodes.
 - 2. Active electrodes.
 - 3. Wire.
 - 4. Mechanical connectors.
 - 5. Exothermic connections.

1.02 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code (NEC), Articles 250 and 517.
- C. ANSI/IEEE 142 (Latest edition):
 - 1. Recommended Practice for Grounding of Industrial and Commercial Power Systems.

1.03 SYSTEM DESCRIPTION

- A. All ground and bonding as required by NEC Article 250.

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on grounding connections. Submit data on made electrodes (as defined by NEC) only when made electrodes are required specifically by the project Drawings.
- C. Manufacturer's Installation Instructions: Submit for active electrodes.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 -00 - Execution and Closeout Requirements: Requirements for submittals.

- B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.06 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, and listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.
- B. Perform Work in accordance with NEC Article 250 and any other special requirements adopted by Authorities Having Jurisdiction.

1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical and mechanical damage, by storing in original packaging.

1.09 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Complete grounding and bonding to building reinforcing steel prior to concrete placement.

PART 2 PRODUCTS

2.01 ROD ELECTRODES

- A. Product Description:
 - 1. Material: Copper-clad steel.
 - 2. Diameter: 3/4 inch.
 - 3. Length: 10 feet (3.5 m) minimum. Rod shall be driven at least 9' 6" deep.
 - 4. Connector: Connector for exothermic welded connection or listed U-bolt clamp.
 - 5. Provide only when shown on the Drawings or when made electrodes per NEC Article 250 are required.

2.02 ACTIVE ELECTRODES

A. Manufacturers:

1. Apache Grounding/Erico Inc.
2. Copperweld, Inc.
3. Erico, Inc.
4. O-Z Gedney Co.
5. Thomas & Betts, Electrical

B. Product Description:

1. Material: Metallic-salt-filled copper-tube electrode.
2. Shape: As indicated on Drawings.
3. Length: 8 feet.
4. Connector: Connector for exothermic welded connection or listed compatible U-bolt clamp.

2.03 WIRE

A. Material: Stranded copper.

B. Foundation Electrodes/Ufer Grounds: Bare copper sized per NEC Article 250, but not smaller than #2 AWG, or as shown on Drawings.

C. Grounding Electrode Conductor: Copper conductor bare, sized per NEC Article 250, but not smaller than #2 AWG or as shown on Drawings.

D. Bonding Conductor: Copper conductor sized per NEC Article 250.

E. Equipment Grounding Conductors: Insulated copper run with circuit conductors and sized as indicated on the Drawings or per NEC Article 250 where size is not indicated on the Drawings. Provide an equipment grounding conductor in all feeders and branch circuits.

2.04 MECHANICAL CONNECTORS

A. Manufacturers:

1. Copperweld, Inc.
2. Erico, Inc.
3. ILSCO Corporation
4. O-Z Gedney Co.

5. Thomas & Betts, Electrical

B. Description:

1. The mechanical connector bodies shall be manufactured from high-strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.
2. Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.
3. The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

2.05 EXOTHERMIC CONNECTIONS

A. Manufacturers:

1. Cadweld, Inc.
2. Erico, Inc.

B. Product Description: Listed exothermic materials, accessories and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.02 PREPARATION

- A. Remove paint, rust, mill oils, surface contaminants at connection points.
- B. Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.
- C. Ground connection surfaces shall be cleaned and all connections shall be made so that they are immovable.
- D. All grounding electrode conductors shall be installed in PVC conduit, in exposed locations.

3.03 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations, and as specified.

3.04 INSTALLATION

- A. Install in accordance with NEC and in accordance with manufacturer's instructions. Unless specifically indicated otherwise on the Drawings, Contractor may utilize any arrangement of components which fully complies with both.
- B. Install grounding and bonding conductors concealed from view to extent practical.
- C. Install grounding electrode conductor and connect to reinforcing steel in foundation footing utilizing a connection method listed for the purpose.
- D. Bond exposed structural steel elements not intentionally grounded as required by NEC 250.104 (C).
- E. Provide code sized copper grounding electrode conductors where required by NEC Article 250.
- F. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use #4 AWG bare copper conductor.
- G. Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

3.05 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS.
- C. Perform ground resistance testing in accordance with IEEE 142. The following tests are acceptable methods for the resistance-to-ground verification:
 - 1. Clamp-on Induced Frequency Resistance-to-Ground method.
 - 2. 3-point Fall-of-Potential method.

END OF SECTION

SECTION 26 05 27 – WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Wall switches; receptacles; and device plates and decorative box covers.
 - 1. Wall Switches.
 - 2. Receptacles.
 - 3. Device Plates, Covers and Colors.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
 - 3. UL 498 - Receptacles
 - 4. UL 20 - Switches

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit manufacturer's catalog information showing dimensions, colors and configurations.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section.

1.05 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each style, size and finish wall plate.

1.06 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer warranty for components.

PART 2 PRODUCTS

2.01 WALL SWITCHES

- A. Manufacturers:
 - 1. Cooper: CSB Series.
 - 2. Hubbell: CSB Series.
 - 3. Leviton: CSB Series.
 - 4. Pass and Seymour: CSB Series.
 - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA WD 1, Commercial Spec Grade AC only general-use snap switch, side and back wired.
- C. Body and Handle: Plastic with toggle handle, unless otherwise noted on plans. Use red for devices connected to emergency systems.
- D. Ratings:
 - 1. Voltage: 120-277 volts, AC.
 - 2. Current: 20 amperes.

2.02 RECEPTACLES

- A. Duplex Receptacle
 - 1. Product Description: NEMA WD 1, WC-596 Federal spec grade receptacle, 20 amp.
 - 2. Configuration: NEMA WD 6, side and back wired.
 - 3. Device Body: Plastic, unless otherwise noted on Drawings. Use red for devices connected to emergency systems.
 - 4. Manufacturers:
 - a. Cooper: 5362 Series
 - b. Hubbell: HBL5362 Series
 - c. Leviton: 5362 Series
 - d. Pass and Seymour: 5362-A Series
 - e. Substitutions: Section 01 60 00 - Product Requirements.

B. Simplex Receptacle

1. Product Description: NEMA WD 1, Commercial Spec Grade receptacle, 20 amp.
2. Configuration: NEMA WD 6, side and back wired.
3. Device Body: Plastic, unless otherwise noted on Drawings. Use red for devices connected to emergency systems.
4. Manufacturers:
 - a. Cooper: 1877 Series
 - b. Hubbell, HBL 5261 Series
 - c. Leviton: 5891 Series
 - d. Pass and Seymour: 5361 Series
 - e. Substitutions: Section 01 60 00 - Product Requirements.

C. GFCI Receptacle

1. Product Description: NEMA WD 1, Heavy-duty general use receptacle, 20 amp. Provide with weather-resistant rating when located outdoors.
2. Configuration: NEMA WD 6, UL943, side and back wired, feed thru type.
3. Device Body: Plastic, unless otherwise noted on Drawings. Use red for devices connected to emergency systems.
4. Manufacturers:
 - a. Cooper: VGF20 Series
 - b. Hubbell: GF20L Series
 - c. Leviton: 8898 Series
 - d. Pass and Seymour: 2095 Series
 - e. Substitutions: Section 01 60 00 - Product Requirements.

2.02 DEVICE PLATES, COVERS AND COLORS

- A. Manufacturers: To match device manufacturer.
- B. Normal system device Colors:
 1. Wall Devices: White
 2. Ceiling Devices: White
- C. Existing and new Emergency system device Colors:
 1. Wall Devices: Red.
- D. Decorative Cover Plate: Smooth nylon.

- E. Jumbo Cover Plate: Smooth nylon. For use at masonry walls only.
- F. Weather Resistant Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover. Provide weatherproof-while-in-use type covers where indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and completely covered by wall plates.
- D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 PREPARATION

- A. Clean debris from outlet boxes.

3.03 EXISTING WORK

- A. Disconnect and remove abandoned wiring devices.
- B. Modify installation to maintain access to existing wiring devices to remain active.
- C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.04 INSTALLATION

- A. Install devices plumb and level.
- B. Install switches with OFF position down.
- C. Install receptacles with grounding pole on top.
- D. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- E. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- F. Connect wiring devices by wrapping solid conductor around screw terminal. When stranded conductors are used in lieu of solid, use back wiring connections. Do not place bare stranded conductors directly under device screws.
- G. Use jumbo size plates for outlets installed in masonry walls.
- H. Install galvanized steel covers on outlet boxes and junction boxes in unfinished areas and

above accessible ceilings.

3.05 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified.

3.06 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify each receptacle device is energized.
- E. Test each receptacle device for proper polarity and ground.
- F. Test each GFCI receptacle device for proper operation.

3.07 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust devices and wall plates to be flush and level.
- C. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- D. Test each system component after installation to verify proper operation.
- E. Test relays, contactors and switches after installation to confirm proper operation. Provide sensitivity adjustments on motion sensors to avoid nuisance, undesired operation.
- F. Confirm correct loads are recorded on directory card in each panel.

3.08 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean exposed surfaces to remove splatters and restore finish.

3.09 DEMONSTRATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate operation of the following system components:

1. Operation of switches.

END OF SECTION

SECTION 26 05 29 – HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
1. Conduit supports.
 2. Formed steel channel.
 3. Spring steel clips.
 4. Sleeves.
 5. Mechanical sleeve seals.
 6. Equipment bases and supports.

1.02 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
1. Hangers and Supports: Submit manufacturer's catalog data including load capacity.
- C. Design Data: Indicate load carrying capacity of hangers and supports.
- D. Manufacturer's Installation Instructions:
1. Hangers and Supports: Submit special procedures and assembly of components.

1.03 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical and mechanical damage, by storing in original packaging.

PART 2 PRODUCTS

2.01 CONDUIT SUPPORTS

- A. Furnish materials in accordance with referenced standards and authority having jurisdiction.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads, 1/4" for single conduits 1" and smaller, 3/8" minimum for trapezes and single conduits 1 1/4" and larger.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit Clamps for Trapeze Hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit Clamps - General Purpose: One-hole plated steel for surface-mounted conduits. Provide with malleable iron clamp backs in damp and wet locations. Provide with pre-galvanized finish.
- F. Cable Ties: High-strength nylon temperature rated to 185 degrees F; self-locking.

2.02 FORMED STEEL CHANNEL

- A. Furnish materials in accordance with referenced standards and authority having jurisdiction.
- B. Product Description: Galvanized 12 gauge thick steel, minimum 1 5/8" x 1 5/8" section when used for trapezes, with holes 1-1/2 inches on center.

2.03 SPRING STEEL CLIPS

- A. Furnish materials in accordance with referenced standards and authority having jurisdiction.
- B. Product Description: Mounting hole and screw closure.

2.04 MECHANICAL AND CONDUIT SLEEVE SEALS

- A. Manufacturers:
 - 1. O-Z/Gedney.
 - 2. Thunderline Link-Seal, Inc.
 - 3. Substitutions: Section 01 60 00 - Product Requirements.
- B. Furnish materials in accordance with referenced standards and authority having jurisdiction.
- C. Product Description: Mechanical type, consisting of rubber sealing elements to

continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

3.02 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors or preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps or spring steel clips. Do not drill structural elements unless approved by Structural Engineer.
 - 3. Concrete Surfaces: Provide expansion anchors.
 - 4. Hollow Masonry, Plaster and Gypsum Board Partitions: Provide toggle bolts.
 - 5. Solid Masonry Walls: Provide expansion anchors.
 - 6. Sheet Metal: Provide sheet metal screws.
- B. Install conduit and raceway support and spacing in accordance with NEC.
- C. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit. Do not fasten to suspended ceiling grid system.
- D. Install multiple conduit runs on common hangers.
- E. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
 - 4. Support vertical conduit at every floor.

5. File and de-bur cut ends of support channel and spray paint with cold galvanized paint to prevent rusting.

F. Install Work in accordance with referenced standards and authority having jurisdiction.

3.03 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

A. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.

END OF SECTION

SECTION 26 05 33 – RACEWAY SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes.

1.02 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).
 - 4. ANSI C80.6 – Intermediate Rigid Conduit
 - 5. ANSI/UL 5 – Surface Metal Raceway
 - 6. ANSI/UL 5 – Surface Non-Metallic Raceway
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.03 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, device mounting, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless

dimensioned. Provide raceway to complete wiring system. Except where other wiring methods are specifically allowed by other sections of the specifications, or specifically indicated on the Drawings, all wiring on this project shall consist of conductors installed in complete raceway systems as specified in this section of the specifications.

1.04 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Product Data: Submit for the following:

1. Flexible metal conduit.
2. Liquid-tight flexible metal conduit.
3. Non-metallic conduit.
4. Flexible non-metallic conduit.
5. Non-metallic tubing.
6. Raceway fittings.
7. Conduit bodies.
8. Wireway.
9. Pull and junction boxes.

1.05 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements.

B. Project Record Documents:

1. Record actual routing of all new conduits. Include locations of junction and pull boxes.
2. Record all circuits transferred to generator backup power.

1.06 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

C. Protect PVC conduit from sunlight.

1.07 COORDINATION

- A. Section 01 30 00 - Administrative Requirement: Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- B. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes. Coordinate locations with architectural features, the work of other trades, obstructions and constraints. Where specific location information is shown on the Architectural Drawings, the information on those Drawings shall govern.

PART 2 PRODUCTS

2.01 SELECTION OF PRODUCTS

- A. Unless specifically indicated otherwise at particular locations on the Drawings, products shall be selected according to installation conditions as described in this article.
- B. Outdoor Below Grade Locations: Non-metallic conduit, schedule 40 or 80.
- C. Outdoor Above Grade Locations and other Wet Locations (as defined by the NEC): Rigid steel or intermediate metal conduit (IMC).
- D. Within or Under Concrete Construction Located On or Below Grade: Non-metallic conduit. Comply with Structural Specifications and Drawings regarding limitations on sizes and placement.
- E. Within Concrete Construction Located Above Grade: Non-metallic conduit, rigid steel conduit or intermediate metal conduit. Comply with Structural Specifications and Drawings regarding limitations on sizes and placement.
- F. Damp Locations as defined by the NEC including exposed work in any protected locations directly communicating with outside ambient air such as crawl spaces, breezeways, covered porches, under canopies, and similar locations: Rigid steel or intermediate metal conduits (IMC) conduits.
- G. Interior Dry Locations (as defined by the NEC): Rigid steel, intermediate metal conduits (IMC), or electric metallic tubing.
- H. Motor and Equipment Connections: Liquid-tight conduit not to exceed 36" in length.
- I. Lighting Fixtures: Flexible metal conduit.

2.02 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5. Install only where specifically indicated on the Drawings.
- C. Intermediate Metal Conduit (IMC): ANSI C80.1.
- D. The term "metal conduit" does not include Electric Metallic Tubing (EMT).

- E. Fittings: NEMA FB 1; material to match conduit.
- F. Conduit Bodies: NEMA FB 1; shall be malleable iron with steel conduit. Aluminum conduit bodies are not acceptable except for use with aluminum conduit.

2.03 PVC-COATED METAL CONDUIT

- A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil (0.1 mm) thick.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.04 NON-METALLIC CONDUIT

- A. Product Description: NEMA TC 2; Schedule 40 or 80 PVC.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.05 FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked steel or aluminum construction. Lightweight extra flexible type is not acceptable.
- B. Fittings: NEMA FB 1.

2.06 LIQUID-TIGHT FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked steel construction with PVC jacket, UL listed for grounding purposes.
- B. Fittings: NEMA FB 1.

2.07 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: NEMA FB 1.
 - 1. Indenter and die-cast set screw types are not acceptable.
 - 2. Wet or Damp Locations: Steel or die-cast compression type.
 - 3. Concealed Dry Locations: Steel compression, die cast compression type, or steel set screw type.

2.08 WIREWAY

- A. Product Description: General purpose or NEMA 3R type wireway suitable for installation conditions.

- B. Knockouts: None; provide in field as required.
- C. Size: As indicated on Drawings or as required to meet NEC fill requirements.
- D. Cover: Screw cover.
- E. Fittings: Lay-in type with captive screws.
- F. Finish: Galvanized in mechanical rooms and unfinished areas; gray powder coated in finished areas and outdoors.

2.09 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. 4" square by 2 1/4" deep minimum size. Provide plaster rings of required depth at recessed locations. Provide compatible industrial device covers and blank covers at other locations.
 - 2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required.
 - 3. Ceiling Boxes imbedded in concrete: Concrete ring type with top cover
 - 4. Outlet boxes in masonry walls or embedded in concrete: Steel masonry type box.
- B. Cast Boxes: NEMA FB 1, material as specified in articles above. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

2.10 PULL AND JUNCTION BOXES

- A. Above Ground: Sheet Metal Boxes: NEMA OS 1, galvanized steel, NEMA Type 1 or 3R as required by installation location.
- B. In Ground: Fiberglass polymer concrete handhole with concrete polymer composite weatherproof cover with nonskid finish

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.02 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.

- B. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- C. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- D. Extend existing raceway and box installations using materials and methods as specified.
- E. Clean and repair existing raceway and boxes to remain or to be re-installed.

3.03 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.04 INSTALLATION – RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceways; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29 and provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports.
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Route exposed raceway parallel and perpendicular to walls.
- H. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- I. Route raceways in and under slab from point-to-point.
- J. Maintain clearance between raceway and piping for maintenance purposes.
- K. Maintain 12 inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

- L. Cut raceways square using saw or pipe cutter; de-burr cut ends.
- M. Bring raceways to shoulder of fittings; fasten securely.
- N. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe non-metallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- O. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in wet locations.
- P. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or provide factory elbows for bends in metal conduit larger than 1" size.
- Q. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- R. Install fittings to accommodate expansion and deflection where raceway crosses expansion joints.
- S. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- T. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- U. Close ends and unused openings in wireway.
- V. Interior Dry Locations (as defined by the NEC): Do not use EMT for exposed work within 48" above finished floor. Do not use EMT for medium voltage cables.
- W. Lighting Fixtures:
 - 1. Conduit size shall be 1/2" minimum and shall not exceed six feet (1.8 M) maximum length.
 - 2. Conduit shall run directly from a junction box to a single fixture. Direct connections between fixtures utilizing flexible metal conduit is not acceptable.
- X. Flexible metal conduit:
 - 1. Use only in dry locations and only where flexibility is necessary for connections to equipment or fixtures.
 - 2. Do not install aluminum type in locations less than 6' above finished floor or working surface.
- Y. Liquid-tight flexible metal conduit: Use in wet or dry locations where flexibility is necessary for connections to equipment or for connections to lighting fixtures.

3.05 INSTALLATION – BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- B. Adjust box location up to 10 feet (3 m) prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 05 27.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) horizontally from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.
- P. Outdoor Above Grade Locations and other Wet Locations (as defined by the NEC): Provide malleable cast iron outlet boxes, "FS" or "FD" series where recessed mounting of outlets is not feasible and for junction boxes in trade sizes 1" and smaller. Utilize malleable iron conduit bodies (condulets) at changes of direction and pull points. Galvanized NEMA 3R steel boxes may be used only at locations where specifically called for on the Drawings, or as approved by the Engineer.
- Q. Damp Locations: Provide malleable cast iron outlet boxes, "FS" or "FD" series where recessed mounting of outlets is not feasible and for junction boxes in trade sizes 1" and smaller. Utilize malleable iron conduit bodies (condulets) at changes of direction and pull points. Galvanized steel boxes may be used only at locations where specifically called for on the Drawings.

3.06 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
- B. Locate outlet boxes to allow luminaires to be positioned as indicated on the Drawings.
- C. Align adjacent wall mounted outlet boxes for switches, thermostats and similar devices.

3.07 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.08 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 43 – UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. The work under this section includes underground cast-in-place concrete ductbanks for electrical power distribution.

1.02 SUBMITTALS

- A. Indicate material specifications, and provide product data on conduit, spacers, terminators, reinforcing steel and related components.

PART 2 PRODUCTS

2.01 CONDUIT

- A. Material: Rigid polyvinyl chloride (PVC) marked at uniform intervals to indicate the kind of material; type Schedule 40 heavy wall, type EB-20 (TC-6), or type EB-35 (TC-8). Type EB PVC conduit is designed for use only in concrete encased installation.
- B. Within five (5) feet of each building wall penetration, install heavy wall galvanized steel conduit within the concrete envelope to provide protection against vertical shearing.

2.02 ELBOWS

- A. Material to match conduit; minimum bend radius of 36 inches (915 mm).

2.03 SPACERS

- A. Plastic, to maintain 3" minimum between conduits.
- B. Install spacers as recommended by conduit manufacturer, but not to exceed a maximum of 6 ft-0 in. on center for PVC conduit and 8 ft-0 in. on center for steel conduit. Stagger conduit joints in concrete encasement 6 in. minimum horizontally.

2.04 CONDUIT TERMINATION IN MANHOLES AND BUILDINGS

- A. Bell Ends:
 - 1. Manufactured bell ends of appropriate sizes at each end of conduit.
- B. Bushings:
 - 1. Steel grounding bushings shall be used on all metal conduit entering a building or manhole.
- C. Seals:

1. Seal interior of conduit entry with "Ductseal" compound.

2.05 PLUGS

- A. Closure plugs or caps of same material as conduit on empty conduits at building entrances and at terminations in equipment pedestals to prevent the entrance of moisture and gases.

2.06 PULL TAPE

- A. Polyester pull tape, 1/2" width, tensile strength of 1,250 lbs. and sequential footage markings along the entire length of the tape as manufactured by Greenlee, Carlon or equivalent. Install pull tape in each empty duct.

2.07 GROUNDING

- A. Steel grounding bushings shall be grounded to manhole or junction box ground.

2.08 DRAINAGE ASSEMBLY

- A.

2.09 CONCRETE ENCASEMENT

- A. Concrete used throughout shall be ready mixed concrete furnished by an approved mixing plant. The plant shall comply with the requirements of National Ready Mixed Concrete Association certification plan.
- B. The concrete mix shall be 3000 psi minimum, 3/8" aggregate, 4 1/2" to 5 1/2" slump.
- C. The slump should be just enough to allow the mix to flow to the bottom of the formation and yet not be so wet as to cause the ducts to float.
- D. The concrete envelope shall contain red dye at 8 lbs. per cubic yard of concrete.

2.10 REINFORCING STEEL

- A. Provide reinforcing steel the entire length of the duct system, four - #4 bars - one in each corner, minimum, or as shown on the drawings.

PART 3 EXECUTION

3.01 EXCAVATIONS

- A. Excavate trenches for ductbank to adequate width, depth, and proper slope as specified.
- B. Install forms on sides of ductbank if trench is not of proper firmness to prevent cave-in.
- C. Bottom of trench shall be undisturbed earth. If trench bottom is too low for proper grade, fill to proper level with sand and mechanically compact it.

- D. Each excavated section from manhole to manhole and from manhole to building shall be completely excavated and graded before any duct is laid in that section.

3.02 PLACEMENT OF CONDUIT

- A. Pitch conduit properly for drainage to manhole or pull box and to prevent low pockets or irregular dips between conduit ends. Minimum pitch to be 4 inches per 100 feet. All ducts shall drain to an open end - preferably a manhole.
- B. Install not more than one 90 degree bend or equivalent between manholes for primary conduit and three 90 degree bends or equivalent for signal conduit or secondary power conduit.
- C. In ductbanks with both primary and signal conduit, primary conduit shall be straight and the signal conduit shall contain bends as necessary to accommodate the primary duct.

3.03 PLACEMENT OF REINFORCING BARS

- A. Install the bars - one in each corner minimum, overlap the joints 12" and tie into the connecting walls of manholes, vaults and buildings, etc.

3.04 PLACEMENT OF CONCRETE

- A. After ducts are in place and before the concrete is poured, the installation shall be inspected by the Engineer's representative. Notify the Engineer's representative at least two days before the time of inspection.
- B. Complete entire section of conduit from manhole to manhole or from manhole to building before encasement by concrete.
- C. Top of concrete envelopes shall be not less than 24 inches below grade.
- D. In placing concrete around the conduit, adjust delivery chute so the fall of the concrete into the trench is minimal.
- E. Provide minimum of 3" (76 mm) of concrete cover over conduit at the top, bottom and sides of the duct bank. Provide troweled crowned top on the concrete to prevent water accumulation.
- F. Place concrete continuously from manhole to manhole to building without interruption.
- G. Extend concrete envelope to finish floor grade or interior wall surface in buildings and finish pad grade at equipment. Maintain moisture seal.

3.05 BACKFILL

- A. Install detectable underground warning tape 12" below finish grade over all ductbanks. Tape shall be 2" wide minimum, 5 mil thickness, and contain a foil core. Tape color shall be red and labeled with the words "CAUTION-BURIED ELECTRIC LINE BELOW" as manufactured by Presco or similar.
- B. Compact backfill around ductbank.

- C. After completion of ductbank installation, return all ground and pavement surfaces to original condition or to condition as indicated on the Drawings. This includes all sidewalks, curbs, streets, parking areas, lawns, shrubs, etc.

3.06 ACCESSORY INSTALLATION

- A. Pull a mandrel/swab (diameter 1/4 in. smaller than conduit) through each conduit in completed ductbank to insure adequate opening of duct run.
- B. Install pull tape in each empty duct.
- C. Install closure plugs or caps on empty conduits at building entrances and at terminations in equipment pedestals to prevent the entrance of moisture and gases.
- D. Ground all steel bushings to manhole or junction box ground.

END OF SECTION

SECTION 26 05 53 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Nameplates.
2. Labels.
3. Wire markers.
4. Conduit markers.
5. Underground Warning Tape.
6. Lockout Devices.
7. Panelboard Directories

B. Related Sections:

1. Section 26 05 19 – 600-Volt Building Wire and Cable

1.02 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures.

B. Product Data:

1. Submit manufacturer's catalog literature for each product required.
2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location and function.

1.03 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

1.04 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section.

1.05 DELIVERY, STORAGE AND HANDLING

A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing and protecting products.

- B. Accept identification products on site in original containers. Inspect for damage.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 PRODUCTS

2.01 NAMEPLATES

- A. Furnish materials in accordance with referenced standards and authority having jurisdiction.
- B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color. Use red lettering on nameplates for emergency system components.
- C. Letter Size:
 - 1. Panelboards: 1 inch (25 mm); identify equipment designation. 1/2 inch (13 mm); identify voltage rating, source and room location of the source.
 - 2. Equipment Enclosures: 1 inch (25 mm); identify equipment designation.
 - 3. Circuit Breakers, Switches, and Motor Starters in Panelboards or Switchboards: 1/2 inch (13 mm); identify circuit and load served, including location.
 - 4. Individual Circuit Breakers, Disconnect Switches, Enclosed Switches, and Motor Starters: 1/2 inch (13 mm); identify source and load served.
- D. Minimum nameplate thickness: 1/8 inch.

2.02 LABELS

- A. Furnish materials in accordance with referenced standards and authority having jurisdiction.
- B. Labels: All labels shall be permanent, and machine generated. NO HANDWRITTEN OR NON-PERMANENT LABELS ARE ALLOWED. Exception: back side of device plates and junction boxes smaller than 8" X 8" may use handwritten, legible labeling on box covers, unless specifically prohibited by other specification sections. Use red lettering on labels for emergency system components.
- C. Embossed tape will not be permitted for any application.

2.03 WIRE MARKERS

- A. Furnish materials in accordance with referenced standards.
- B. Description: Cable label size shall be appropriate for the conductor or cable size(s), outlet faceplate layout and patch panel design. All labels shall be self-laminating, machine generated and be wrapped around the cable or sheath. Flag type labels are not acceptable. The labels shall be of adequate size to accommodate the circumference of the cable being labeled and properly self-laminate over the full extent of the printed area of the label.
- C. Legend:
 - 1. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.
- D. Tape (phase identification only): Scotch #35 tape in appropriate colors for system voltage and phase.

2.04 CONDUIT AND RACEWAY MARKERS

- A. Furnish materials in accordance with referenced standards.
- B. Description: Nameplate fastened with adhesive, labels fastened with adhesive and stencils.
- C. Color:
 - 1. Medium Voltage System: Black lettering on white background.
 - 2. 480 Volt System: Black lettering on white background.
 - 3. 208 Volt System: Black lettering on white background.
- D. Legend:
 - 1. Medium Voltage System: HIGH VOLTAGE.
 - 2. 480 Volt System: 480 VOLTS.
 - 3. 208 Volt System: 208 VOLTS.

2.05 UNDERGROUND WARNING TAPE

- A. Provide detectable underground warning tape, yellow background, black letters, 6" width, equal to Ideal #42-251, with suitable warning legend describing buried electrical lines.

2.06 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Anodized aluminum hasp with erasable label surface; size minimum 7-1/4 x 3 inches.

2.07 PANELBOARD DIRECTORIES

- A. Typed directories for panels must be covered with clear plastic, have a metal frame. Room number on directories shall be Owner's numbers, not Plan numbers unless Owner so specifies.

PART 3 EXECUTION

3.01 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.02 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.
- B. Install identification on unmarked existing equipment.
- C. Replace lost nameplates, labels and markers.
- D. Re-stencil existing equipment.

3.03 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using adhesive.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 - 6. Install nameplates for the following:
 - a. Panelboards transferred to emergency source.
 - b. Transformers transferred to emergency source.
 - c. Disconnects.
 - 7. Nameplates shall include equipment designation, supply voltage, secondary

voltage (for transformers) and feeder source designation.

C. Label Installation:

1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations.
3. Install labels for permanent adhesion and seal with clear lacquer.
4. Install labels for junction boxes.
5. Install labels for conduits at panelboards and penetrations.
6. Install labels for all receptacles with serving panel and circuit number.
7. Install labels for all receptacles transferred to the emergency source with serving panel and circuit number.

D. Wire Marker Installation:

1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes.

E. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

SECTION 26 05 73 – SHORT CIRCUIT/COORDINATION STUDY AND ARC FLASH HAZARD STUDY

PART 1 GENERAL

1.01 SUMMARY

- A. The contractor shall retain the services of an independent third-party firm to perform a short circuit/coordination study and arc flash hazard study as described herein.
- B. The study and assessment shall be performed utilizing SKM's Captor, Dapper, and Power Tool software products.
- C. Section includes a short circuit, protective device coordination and arc flash hazard study. The study shall be performed in accordance with all applicable current edition IEEE 1584 requirements.
- D. Shock hazard analysis will be based on the latest version of NFPA 70E. The results of that analysis will be printed on the arc flash labels printed and furnished by the study preparer and affixed by the installing contractor.
- E. The analysis will consider alternative modes of operation in addition to the normal operating configuration, as applicable.
- F. Fault current contributions from motors 50HP or larger shall be individually analyzed at their point of connection in the system. Contributions for smaller motors may be grouped and considered to be connected at the system source for analysis.
- G. The short circuit portion of the study shall include evaluation of the adequacy of all motor controllers (including VFD's) serving motors 10HP or above.
- H. All portions of the system from the source(s) through final overcurrent devices shall be included except those portions specifically excluded below.
- I. Single phase circuits may be excluded.
- J. Circuits and equipment operating at 240V and below may be may be excluded if served by a transformer 125 kVA or smaller transformer in its upstream power supply.

1.02 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.

1.03 DESIGN REQUIREMENTS

- A. Complete Short Circuit and Protective Device Coordination Study to meet requirements of NFPA 70 and these specifications.

B. Report Preparation:

1. Prepare study prior to ordering distribution equipment to verify equipment ratings required.
2. Perform study with aid of computer software program.
3. Obtain actual data for packaged chillers and motor characteristics for all motors 100 HP and larger for equipment incorporated into Work. Obtain utility fault current data from the utility company.
4. Calculate short circuit interrupting and, when applicable, momentary duties for assumed 3-phase bolted fault short circuit current and phase to ground fault short circuit current at each of the following:
 - a. Utility supply bus.
 - b. Automatic transfer switch.
 - c. Engine generator.
 - d. Switchboards.
 - e. Distribution panelboards.
 - f. Branch circuit panelboards.
 - g. Each other significant equipment location throughout system.

C. Report Contents:

1. Include the following:
 - a. Calculation methods and assumptions.
 - b. Base per unit value selected.
 - c. One-line diagram.
 - d. Source impedance data including power company system available power and characteristics.
 - e. Typical calculations.
 - 1) Fault impedance.
 - 2) X to R ratios.
 - 3) Asymmetry factors.
 - 4) Motor fault contribution.
 - 5) Short circuit kVA.
 - 6) Symmetrical and asymmetrical phase-to-phase and phase-to-ground fault currents.
 - 7) Tabulations of calculation quantities and results.
 - f. One-line diagram revised by adding actual instantaneous short circuits available.
 - g. State conclusions and recommendations.
2. Prepare time-current device coordination curves graphically indicating coordination proposed for system, centered on conventional, full-size, log-log forms.
3. Prepare with each time-curve sheet complete title and one-line diagram with legend identifying specific portion of system covered by that particular curve sheet.

4. Prepare detailed description of each protective device identifying its type, function, manufacturer and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous and time delay settings.
5. Plot device characteristic curves at point reflecting maximum symmetrical fault current to which device is exposed. Include on curve sheets the following. Omit items a through d beyond low-voltage service equipment.
 - a. Power company relay characteristics.
 - b. Power company fuse characteristics.
 - c. Low voltage equipment circuit breaker trip device characteristics.
 - d. Low voltage equipment fuse characteristics.
 - e. Cable damage point characteristics.
 - f. Pertinent transformer characteristics including:
 - 1) Transformer full load current.
 - 2) Transformer magnetizing inrush.
 - 3) ANSI transformer withstand parameters.
 - 4) Significant symmetrical fault current.
 - g. Pertinent motor characteristics.
 - h. Generator characteristics including:
 - 1) Phase and ground coordination of generator protective devices.
 - 2) Decrement curve and damage curve.
 - 3) Operating characteristic of protective devices.
 - 4) Actual impedance value.
 - 5) Time constants.
 - 6) Current boost data.
 - 7) Do not use typical values for generator.
 - i. Transfer switch characteristics.
 - j. Other system load protective device characteristics.

1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Qualifications Data: Submit the following for review prior to starting study.
 1. Submit qualifications and background of firm.
 2. Submit qualifications of Professional Engineer performing study.
- C. Product Data: Submit the following:
 1. Report: Summarize results of study in report format including the following:
 - a. Descriptions, purpose, basis and scope of study.
 - b. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties, and commentary regarding same.

- c. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
 - d. Fault current calculations including definition of terms and guide for interpretation of computer printout.
 - e. Tabulations of data required for ordering arc flash hazard labels.
- D. Submit copies of final report signed and sealed by the professional engineer.
- E. Make additions or changes required by review comments.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Texas and local municipality standards.
- B. Maintain one copy of document on site.
- C. Use commercially available software, designed specifically for short circuit and protective device coordination studies with minimum of 5 years documented availability approved by Architect/Engineer.
- D. Perform study in accordance with IEEE 242.

1.06 QUALIFICATIONS

- A. Study Preparer: Must be a professional engineer licensed in the State of Texas and qualified in performing work of this section with minimum 5 years of documented experience and having completed three projects of similar size and complexity within the past ten years.
- B. Demonstrate that the engineer performing study has capability and experience to provide assistance during system startup.

1.07 PRE-WORK MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-work meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.08 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Complete study within eight weeks after pre-work meeting.
- C. Allow two weeks for review of completed study by Architect/Engineer.
- D. Submit short circuit and protective device coordination study to Architect/Engineer prior to receiving final approval of distribution equipment shop drawings and prior to releasing equipment for manufacturing.
- E. When formal completion of study will cause delay in equipment manufacturing, obtain approval from Architect/Engineer for preliminary submittal of study data sufficient in scope to ensure selection of device ratings and characteristics will be satisfactory.

1.09 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements.
- B. Section 01 32 16 - Construction Progress Schedule: Requirements for scheduling.
- C. The contractor shall provide the required data for preparation of the studies. The engineer performing the system studies shall furnish the contractor with a listing of the required data immediately after award of the contract.
- D. The contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacture.

1.10 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate work with local power company. Obtain available fault current at point of service from utility.

1.11 FINAL STUDY REPORT

- A. Provide studies in conjunction with equipment submittals to verify equipment ratings required.
- B. The results of the power system study shall be summarized in a final report. Six (6) bound copies of the final report shall be submitted. Provide two (2) copies in PDF format of the study, so that it can be more easily stored and shared. Also, provide 2 copies (on CD) of the report in MS word, and 2 copies (on CD) of the one-line diagram in CAD format.
- C. The report shall include the following sections:
 - 1. Overview
 - 2. Short Circuit Study
 - a. SC-1: Purpose
 - b. SC-2: Explanation of Data
 - c. SC-3: Assumptions
 - d. SC-4: Analysis of Results
 - e. SC-5: Recommendations
 - f. SC-6: DAPPER Fault Analysis Input Report
 - 3. Protective Device Coordination Study
 - a. PDC-1: Purpose
 - b. PDC-2: Explanation of Data
 - c. PDC-3: Assumptions
 - d. PDC-4: Analysis of Results
 - e. PDC-5: Recommendations (Including NEC 700-27 Requirement)
 - f. PDC-6: CAPTOR Results
 - g. PDC-7: Example Drawings

4. Arc Flash Study
 - a. ARC-1: Purpose
 - b. ARC-2: Explanation of Data
 - c. ARC-3: Assumptions
 - d. ARC-4: Analysis of Results
 - e. ARC-5: Recommendations
 - f. ARC-6: SKM Arc Flash Evaluation Report
 5. Prioritized Recommendations and Conclusions
 6. Appendices
 - a. APP-1: DAPPER One-line Diagrams
 - b. APP-2: AutoCAD One-line Diagrams
 - c. APP-3: SKM Protective Device Summaries
 - d. APP-4: Reference Data
 - e. APP-5: Sample Work Permit Form
 - f. APP-6: Copy of Warning Labels, including study date
- D. The above sections shall include the following items in detail:
1. Short circuit studies shall evaluate the available fault current at each bus (each change of impedance), including all three-phase motors.
 2. Coordination study recommendations for relay settings, breaker settings, and motor protection settings.
 3. Recommendations for improving the coordination and/or load distribution, as well as ground fault requirements.
 4. Arc flash values for two normal cases to define the highest values (low short circuit and high short circuit).
 5. Arc flash values for two maintenance cases, which define the arc flash values available at the equipment that would be available if the instantaneous trip of the upstream circuit breaker is set at the study-recommended setting.
 6. IEEE standard one-line diagram with equipment evaluation and circuit breaker setting forms that clearly define the system data and are easy to interpret.
 7. Prioritized report summarizing all recommendations from this study. This shall include observed NEC code violations and their corrective action.
 8. The contractor shall provide a one-line diagram that meets IEEE/ANSI standard 141, mounted on 24" x 36" (minimum) Styrofoam backboard for mounting in Main Electrical Service Room.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.01 SHORT CIRCUIT AND COORDINATION STUDY

- A. The short circuit, coordination, and arc flash hazard studies shall be performed using SKM Dapper, Captor and PowerTool for Windows software packages. In the short circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, and recommendations. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit KVA and symmetrical and asymmetrical fault currents.
- B. In the protective device coordination study, provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full-size, log-log forms. Include with each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
- C. Include on the curve sheets power company relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. Include at least all devices down to largest branch circuit and largest feeder circuit breaker in each motor control center, and main breaker in branch panelboards.
- D. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400 or 600 percent currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault currents. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed.
- E. Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics, including a point equal to 58 percent of the ANSI withstand point to provide secondary line-to-ground fault protection. Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16 percent current margin to provide proper coordination and protection in the event of secondary line-to-line faults.
- F. Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on drawing one-lines.
- G. Utilize equipment load data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

- H. Include fault contribution of all motors in the study. Notify the Engineer in writing of circuit protective devices not properly rated for fault conditions.
- I. Provide settings for the chiller motor starters or obtain from the mechanical contractor, include in the study package, and comment.
- J. When an emergency generator is provided, include phase and ground coordination of the generator protective devices to meet NEC 700.27 requirements. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.
- K. Evaluate proper operation of the ground relays in 4-wire distributions with more than one main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.
- L. For motor control circuits, show the MCC full-load current plus symmetrical and asymmetrical of the largest motor starting current to ensure protective devices will not trip major or group operation.

3.02 ARC FLASH HAZARD STUDY

- A. As part of the short circuit and coordination study, arc flash hazard study shall be included. The study shall include the following:
 - 1. Determine and document all possible utility and generator/emergency sources that are capable of being connected to each piece of electrical gear. Calculations shall be based on highest possible source connection.
 - 2. Calculations to conform to National Fire Protection Association (NFPA) 70E calculation standards. All incident energy units shall be calculated in calories per square centimeter.
 - 3. Provide recommended boundary zones and personal protective equipment (PPE) based on the calculated incident energy and requirements of NFPA 70E-2003 for each piece of electrical gear.
- B. Electrical Contractor shall provide labeling as required by OSHA based upon the results of the arc flash hazard study. At a minimum, the labeling shall contain the following information: PPE level, Flash Hazard Boundaries, Flash Protection Boundary, and Shock Hazard Boundaries such as Limited Approach Boundary, Restricted Approach Boundary, Prohibited Approach Boundary, and study date.

3.03 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting and balancing.
- B. Provide assistance to electrical distribution system equipment manufacturer during start up of electrical system and equipment.

- C. Select each primary protective device for delta-wye connected transformer so device's characteristic or operating band is within transformer characteristics, including point equal to 58 percent of ANSI withstand point to provide secondary line-to-ground fault protection.
- D. Separate transformer primary protective device characteristic curves from associated secondary device characteristics by 16 percent current margin to provide proper coordination and protection in event of secondary line-to-line faults.
- E. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study, protective device coordination study and arc flash hazard study.

3.04 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Verify field adjustments of protective devices and modifications to equipment to place equipment in final operating condition. Verify settings in accordance with approved short circuit and protective device coordination study.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- A. See Specification 01 9113 General Commissioning Requirements.

END OF SECTION

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SECTION 26 09 23 - LIGHTING CONTROL SYSTEM

PART 1 GENERAL

1.01 OVERVIEW

A. Section Includes:

1. Digital Lighting and Plug Load Controls.
2. Relay Panels.
3. Emergency Lighting Control (if applicable).

B. Related Sections:

1. Section 26 05 27 - Wiring Devices: Receptacles, line voltage lighting controls.
2. Section 26 51 16 – Interior Lighting: Fixtures, lamps, ballasts, and fluorescent electronic dimming ballasts.
3. Section 26 08 00 – Electrical Commissioning.
4. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section

C. References

1. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
2. International Electrotechnical Commission (IEC)
3. International Organization for Standardization (ISO)
4. National Electrical Manufacturers Association (NEMA)
5. WD1 (R2005) - General Color Requirements for Wiring Devices.
6. Underwriters Laboratories, Inc. (UL):
 - a. 20 – Plug Load Controls
 - b. 508 – Industrial Controls
 - c. 916 – Energy Management Equipment
 - d. 924 – Emergency Lighting

D. Provide a complete low voltage lighting control system for the building as shown on the plans and specified herein.

- E. Lighting control system shall utilize networking technology connecting relay panels, switches and sensors based upon a 2-wire data line providing both power and data to all field devices. The network shall be free topology; therefore, a serial loop is not necessary to achieve maximum network distance. The system shall utilize a web server device complete with a touch screen located in a relay panel so that programming and viewing of status can be accomplished at the panel or by any PC connected to the same LAN or via the internet.
- F. All relay panel interiors shall be pre-assembled complete with the necessary relays, transformers and devices. Relay panels that are wall mounted shall have interiors separate from enclosure so as to permit easy mounting, conduit installation and wire pull to enclosures. Enclosures mounted in the ceiling space are not required to have separate interiors.

1.02 QUALIFICATIONS

- A. All components are to be supplied by same manufacturer. Manufacturer to be a supplier of this type of equipment for over 10 years.

1.03 SUBMITTALS

- A. Submit a one-line diagram of the proposed system configuration for review.
- B. Supply manuals on system components to permit ease of installation, system operation and maintenance including, but not limited to the following:
 - 1. Lighting control system step-by-step operating instructions.
 - 2. Relay panel schedules indicating circuits connected, inputs assigned, area controlled, panel location and panel equipment details.

PART 2 PRODUCTS

2.02 MANUFACTURERS

- A. Acuity nLight.
- B. Douglas Lighting Controls.
- C. Eaton Greengate.

2.03 RELAYS

- A. Lighting control relays shall be mechanically latching and shall come complete with a manual ON/OFF switch. The mechanical switch shall continuously display the true state of the relay's internal contacts.
- B. Single pole relays shall be rated and UL/CSA listed for 120VAC, 277VAC and 347VAC lighting loads at 20 amps (30A General Use) and have a general, tungsten, standard and electronic ballast rating.
- C. Double pole relays shall be rated and UL listed for 208VAC, 240VAC and 480VAC and CSA for up to 347VAC lighting loads at 20 amps and have a general, tungsten, standard and electronic ballast rating.

- D. The relays shall have a label indicating the short circuit fault current rating as per the NEC. The relays shall have passed UL 508 short circuit tests at 14,000 amperes.
- E. Each lighting control relay shall be capable of controlling incandescent, fluorescent, electronic ballast and H.I.D. lighting loads and have an inrush capability of 3000 amperes. Relays shall be complete with a 5-year Manufacturer's Limited Warranty.
- F. Lighting control relays shall include captive screw terminals for both the line voltage and the low voltage connections. Switching the relay shall be accomplished with ONE signal wire and a common return. The signal wire shall be able to signal ON and OFF and shall carry status current that indicates if the relay is ON or OFF.

2.04 PRE-ASSEMBLED RELAY PANELS

- A. Where indicated on the drawings, provide a factory pre-assembled relay panel. The panel's enclosure shall be for surface or flush installation, with a screw-on cover or a hinged door assembly as required.
- B. The panel shall consist of a pre-assembled interior insert; UL/CSA approved with capacities for 6, 12, 24, 48 or 72 relays as required. Panel enclosure must be UL/CSA Approved.
- C. Panel interior shall have the following pre-assembled and pre-wired:
 - 1. Suitable divider separating class 1 and class 2 compartments.
 - 2. Control transformer, UL/CSA approved for class 2 circuits.
 - 3. Low voltage relays as required by switched circuits shown on plans or schedules.
 - 4. Control devices as required.

2.05 DEVICE NETWORK CONTROLS - LIGHTING CONTROL UNIT

- A. The Lighting Control Unit (LCU) shall be able to operate the local lighting control system on a stand-alone basis. For large installations that require multiple LCUs, all units must be able to operate on a stand-alone basis should they become disconnected from the network.
- B. The LCU shall provide the following user interfaces for viewing and editing data:
 - 1. Built-in touch screen with editable IP address field for convenient at panel configuration and providing web accessible configuration.
 - 2. Built-in web server, accessed via TCP/IP connection.
 - 3. LCU shall be accessible via a web browser with no additional software required.
- C. Each LCU shall provide the following standard lighting control functions:
 - 1. Program and control up to 252 relays and 252 dimmers.

2. Link Outputs to switches and/or sensors to provide ON/OFF, Preset, or Dim Up/Down commands. In addition, functions such as Flick Warn, Time Out, Natural Daylight, Enable/Disable and Quiet Time can be associated with switches, sensors and relays and have these features scheduled by time-of-day or date.
 3. Be able to group Outputs and Inputs to facilitate various control schemes.
 4. Be able to program peripheral devices (switches, sensors, etc.) to function differently based on specific situations such as time-of-day, demand response status, user intervention, etc.
 5. Photo Sensor to provide Dusk-to-Dawn (switching) and/or Natural Daylight (dimming) with multiple set points to different groups.
 6. Astronomic Controls for Dusk-to-Dawn applications not requiring Photo Sensor.
 7. Provide Log Reports for diagnostic and run-time tracking purposes.
 8. Time Schedule types include: 7-day weekly scheduling, 365-day date specific, Holiday, and event scheduling.
- D. The system shall have pre-defined logical applications for lighting controls.
1. Astronomical Time Clock
 2. Natural Daylight (CLC) – Open Loop & Close Loop
 3. Exterior Threshold Photo Control
 4. Time Out (Unoccupied Mode)
 5. Quiet Mode
 6. Permanent Block
 7. Flick Warn
- E. The system must shall the ability to operate multiple items and modes with a single action and sequence them with time offsets.
- F. Behaviors: The system shall have the ability to program multiple actuations and modes with a single activation. Each item must be able to be programmed with a time offset. When the deactivation occurs a separate and unique list of actuations can be programmed.
- G. Triggers: The system shall be able to utilize the status or the one or many relay/group statuses to send an actuation to the system. The statuses must be able to be programmed in an AND or OR logic.
- H. Each LCU shall provide the following system functions:
1. Demand response: connection via contact input.

2. Accept configuration updates via USB port or Ethernet connection.
3. Backup data via Ethernet or USB port.

2.06 ROOM CONTROLLER

- A. Where indicated on the drawings provide a pre-configured, digitally addressable, plenum-rated room controller.
- B. The Room Controller shall be capable of:
 1. Autonomously controlling a space.
 2. Networking to a central control system.
 3. Networking to a central BACnet based management system.
- C. THE ROOM CONTROLLER SHALL CONSIST OF:
 1. A universal voltage type (120Vac/277Vac/347Vac) power supply.
 2. Four 20A rated relays complete with manual override. Circuit Load rating dependent on usage. One circuit dedicated for 20A receptacle control.
 3. Four 0-10V control channels, capable of 100mA current sinking
 4. A port to connect downstream switches, occupancy sensors and daylight sensors. All downstream devices shall connected via two #18AWG, non-polarized, non-shielded, non-twisted conductors. See Section 3.4 for wiring specifications.
 5. A port to connect to an upstream Lighting Control Unit.
 6. A port to connect upstream to BACnet IP building management system. The Controller shall communicate using native BACnet command objects appropriate for the application.
 7. An indicating LED to aid in locating the controller in a darkened ceiling space.
 8. Circuit testing buttons
 9. Capable of connecting with WUL-3924
 10. Output 24Vac 120mA
 11. Relay Ratings
 12. 20A Suitable for General Purpose Loads @ 120/277/247VAC
 13. 20A Suitable for Standard Ballasts and Tungsten Loads @ 120/277VAC
 14. 15A Suitable for Standard Ballasts Only @ 347VAC
 15. 16A Suitable for Electronic Ballasts @ 120/277VAC

- 16. 0.5HP @120/277Vac
- 17. US & Canada Plenum Rated

- D. The Room Controller relays shall be connected such that 120Vac plug load(s) and 277Vac/347Vac lighting loads can be switched by a single Controller with no additional add-ons or remote modules
- E. The Room Controller shall mount to electrical junction box via threaded ½" chase nipple. No other mounting hardware shall be required.

2.07 ROOM CONTROLLER UL924 RELAY EXPANSION PACK

- A. Where indicated on the drawings provide a 2-relay expansion pack consisting of two independently controllable, 20A relays capable of emergency lighting circuit control.
- B. Expansion pack relays shall force EM lights on when the Room Controller loses power.
- C. The expansion pack shall connect to the Room Controller. No wires or tools shall be required to add an expansion pack to a Room Controller. The Room Controller will include a means for remote mounting.
- D. Circuit testing buttons

2.08 RELAY CONTROLS INSTALLED IN RELAY PANELS - RELAY DRIVERS

- A. The low voltage relays shall be connected to the system by a relay driver unit. Each relay driver has 8 outputs and shall provide enough relay driver units so that each relay in the system is connected to an output.
- B. Relay drivers shall be able to control relays ON and OFF, determine relay status, provide feedback as to whether a relay is connected and be addressable within the network.

2.09 DIMMING BALLAST CONTROL - BALLAST DRIVERS

- A. The system shall be able to control industry standard 0-10VDC dimming ballasts or 0-10VDC LED drivers by using the Dimming Ballast Module. Each shall have 4 dimming address outputs, be able to support 35 ballasts per output and support sink current of 100mA per output.

2.10 BACNET IP GATEWAY

- A. If required, the system shall have the ability to communicate to a system integrator or other software specialist to program the system. It shall be possible to view/control the system via the BACnet integration software through TCP/IP connection. The system shall provide the following features:
 - 1. Program and control up to 252 relays and dimming points.
 - 2. Control and receive status for Groups
 - 3. Control and receive status for Presets

4. Receive status from Occupancy Sensors

2.11 WALL SWITCH

- A. Switches shall connect to the lighting control network via a common 2-wire, non-polarized data line. Switches shall be configured and programmed to control one or more outputs in the lighting control system.
- B. Switches shall have the capability to be configured an infrared setting unit that accesses programming fields of the switch without removing the switch from the wall box.
- C. Switches are linked to a single output or a group of outputs.
- D. Switches, Occupancy Sensors and Photo Sensors can be set to a common output address to permit multiple points of control for a single relay or dimming output.
- E. Switches, Occupancy Sensors and Photo Sensors can be set to a common group address to permit multiple points of control for a group of outputs.
- F. Each switch can be programmed for ON/OFF control of outputs, UP/DOWN control of 0-10VDC dimming ballasts, 0-10VDC LED drivers and/or preset control to set a specific lighting scene.
- G. Switches, with LED indicators to indicate both ON and OFF output/group status, shall be available with 1, 2, 3, 4 or 8 single button switches per gang. Switch to fit standard Decora opening.
- H. Switches and switch hardware shall mount to standard wall boxes.
- I. Each switch shall provide a location for a label to identify function. The label shall be under a clear plastic cover and shall be field replaceable should the operation of the switch change. Permanently etched switches are not acceptable.
- J. Adhere to the factory recommended wiring practices so that physical removal of any single switch shall still permit communication between relay panels in the rest of the lighting control network.

2.12 KEYED SWITCH

- A. Keyed switches shall be connected to the lighting control network via a 2-wire, non-polarized data line.
- B. Keyed ON/OFF switches shall include LED indicators for ON and OFF status.
- C. Keyed switches can be programmed to control individual outputs or groups of output and can also be programmed to enable/disable peripheral devices such as switches or sensors.
- D. Each keyed action, clockwise and counter-clockwise, shall allow for independently programmed functions.
- E. Keyed switches can be programmed with an infrared setting unit.

2.13 DIMMER SWITCH

- A. Dimmer switches shall be connected to the lighting control network via a 2-wire, non-polarized data line. Each switch shall be capable of raising or lowering light levels of individual or groups of lighting fixtures.
- B. Switches shall include integral LED indication for light levels as well as a switch for ON/OFF control.
- C. Dimmer switch can be programmed with an infrared setting unit.

2.14 CEILING SENSOR

- A. Sensors shall be Dual Technology with Passive Infrared (PIR) and ADI-Voice detection.
- B. Ceiling sensors shall mount recessed in to the ceiling space.
- C. Sensors shall have a 360 degree coverage pattern with an adjustable tilt head to maximize coverage, focus on particular areas, or provide adjustment when mounted on sloped ceilings.
- D. Sensors shall provide an adjustable time out period of 30 seconds to 30 minutes.
- E. A transformer shall be used if required.
- F. If a Photo Sensor is required, it shall be incorporated into the Occupancy Sensor device and operate so that when occupancy is detected, the sensor will only allow the load to be switched ON if the light level is below the daylight level set by the user.
- G. A Manual Override Switch is to be provided on the sensor to allow the load to be manually switched ON and OFF for the purpose of testing during installation.
- H. Where 2 level switching is required, a 2-pole sensor shall be provided. The sensors must be able to be set to activate alternating poles to provide even lamp wear.
- I. Provide as required on the plans, options that are available from the following list:
 - 1. 0-10VDC outputs for dimming ballast option for Natural Daylight with user settable light levels
 - 2. Configurable high and low light level set points so that the sensor can toggle between light levels upon occupancy
 - 3. Auxiliary relay, for signaling other systems, which can be configured so that it synchronizes with the ON/OFF status of the load or the status of occupancy/vacancy
 - 4. Remote Manual Override Switch

2.15 CONTACT INPUT

- A. When inputs from other devices (including other manufacturers) are required. Each unit shall provide DC power for each sensor and will accept a momentary or maintained contact signal from each sensor that can be assigned to any relay or group. Check with factory to ensure compatibility.

- B. Devices connected to the input unit shall include the following features:
 - 1. Adjustable Timeout (3 min to 30 min).
 - 2. Function selection: ON only, OFF only, toggle (ON/OFF)
 - 3. Multiple sensors may work together using either direct connection to sensors or via multi-sensor function built into WCI-3928 units.

2.16 PHOTO SENSOR & DAYLIGHT CONTROLS - EXTERIOR DAYLIGHT SENSOR

- A. Provide where required an Exterior Daylight Sensor capable of sensing from 0 to 65,000 lux (0 to 6500 fc) of direct light. The sensor shall derive both its power and data information from the data line.
- B. The ambient light level shall be continuously monitored in lux by the sensor. The sensor shall broadcast to the network the existing light level when requested or when there is a change in detected light level.
- C. Set point adjustments can be made via a touch screen or web server interface.
- D. Each sensor can be programmed to provide ON/OFF control of relays, raise/lower of 0-10vdc ballasts and LED drivers via a touch screen or web server interface.
- E. One sensor shall permit different outputs to switch and/or control light levels as ambient light changes. Light levels shall be controlled by 'sensor only' or in combination with a time schedule or with a dimming switch.
- F. It shall be possible to set a maximum light level which cannot be exceeded during Natural Daylight operations or for non-daylight controlled areas, a permanent or "tuned" light level to maximize energy savings.

2.17 PHOTO SENSOR & DAYLIGHT CONTROLS - INTERIOR DAYLIGHT SENSOR

- A. Provide where required an Interior Daylight Sensor capable of sensing from 0 to 65,000 lux (0 to 6500 fc) of direct light. The sensor shall derive both its power and data information from the data line.
- B. The ambient light level shall be continuously monitored in lux by the sensor. The sensor shall broadcast to the network the existing light level when requested or when there is a change in detected light level.
- C. Set point adjustments can be made via a touch screen or web server interface
- D. Each sensor can be programmed to provide ON/OFF control of relays, raise/lower of 0-10vdc type or ballasts and LED drivers via a touch screen or web server interface.
- E. One sensor shall permit different outputs to switch and/or control light levels as ambient light changes. Light levels shall be controlled by 'sensor only' or in combination with a time schedule or with a dimming switch.

- F. It shall be possible to set a maximum light level which cannot be exceeded during Natural Daylight operations or for non-daylight controlled areas, a permanent or “tuned” light level to maximize energy savings.

2.18 INFRARED SETTING UNIT

- A. Provide an Infrared Setting Unit to facilitate the following functions:
- B. Set input device and address
- C. Configure input device presets, group, and individual control
- D. Set local or global functionality
- E. Wireless Devices – Bluetooth® Dimmer Switch
- F. Dimmer switches
- G. Wireless dimmer switches shall communicate with wireless devices via wireless Bluetooth® mesh.
- H. Each wireless dimmer switch shall be capable of raising or lowering light levels of individual or groups of lighting fixtures.
- I. Wireless dimmer switches shall include integrated LED indicators for light levels as well as an ON/OFF switch.
- J. Wireless dimmer switches shall be configurable with a smartphone Bluetooth® App

PART 3 INSTALLATION

3.01 RELAY PANELS AND CONDUIT.

- A. Ensure that conduit for line voltage wires enters panel in line voltage areas and conduit for low voltage control wires enters panel on low voltage areas. Check manufacturer's drawings for location of line and low voltage areas.

3.02 DAYLIGHT SENSORS

- A. Install daylight sensors as per manufacturer's recommendations for closed loop and open loop applications. Ensure there is no artificial light shining directly into the sensor head.
- B. Adhere to manufacturer's recommendations for wiring and programming.

3.03 OCCUPANCY SENSORS

- A. Install Occupancy Sensors so objects do not block the coverage area. Keep away from HVAC vents and light directly from light fixtures.
- B. Adhere to manufacturer's recommendations for location, wiring and programming.

3.04 WIRING

- A. For low voltage wiring, provide wire type as recommended by the manufacturer.
- B. Adhere to manufacturer's recommendations as to maximum wire length and maximum quantity of relays per switch.
- C. Data line shall be single pair #18AWG LVT wire type or equivalent.

3.05 LINE VOLTAGE WIRING

- A. Use wire gauges from #12AWG to #14AWG as appropriately sized for the branch circuit.

3.06 OPTIONAL PRE-INSTALLATION MEETING

- A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
 - B. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
 - C. Review the specifications for low voltage control wiring and termination.
 - D. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 - E. Discuss requirements for integration with other trades.

3.07 CONTRACTOR INSTALLATION AND SERVICES

- A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.
- B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturer with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.
- C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.
- D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
- E. Adjust time delay so that controlled area remains lighted while occupied.

- F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
- G. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
- H. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
- I. Load Parameters (e.g. blink warning, etc.)
- J. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activities.

3.08 OPTIONAL FACTORY SERVICES

- A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete, fully functional system.
- B. The electrical contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.
- C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

END OF SECTION

SECTION 26 22 13 – LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes two-winding transformers; shielded transformers; autotransformers; and buck-and-boost transformers.
- B. Related Sections:
 - 1. Section 26 05 33 - Raceway and Boxes for Electrical Systems.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ST 1 - Specialty Transformers (Except General Purpose Type).
 - 2. NEMA ST 20 - Dry Type Transformers for General Applications.
 - 3. DOE 2016 Efficiency Standards

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.
- C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years of experience.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Store in clean, dry space. Maintain factory wrapping or provide additional canvas or plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to transformer internal components,

enclosure, and finish.

PART 2 PRODUCTS

2.01 DRY-TYPE TRANSFORMERS

- A. Manufacturers:
 - 1. Eaton/Cutler-Hammer.
 - 2. ABB/General Electric.
 - 3. Schneider Electric/Square D.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as indicated on Drawings, conforming to DOE 2016 energy efficiency requirements.
- C. Primary Voltage: As scheduled.
- D. Secondary Voltage: As scheduled.
- E. Insulation System:
 - 1. 1-15 kVA: Class 185.
 - 2. 16-500 kVA: Class 220.
- F. Average Temperature Rise: As scheduled.
- G. Hot Spot Temperature: Do not exceed 35 degrees C rise above average at warmest point at full load.
- H. Winding Taps:
 - 1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
 - 2. Transformers 15 kVA and Larger: NEMA ST 20.
- I. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:
 - 1. 1-50 kVA: 45 dB.
 - 2. 51-150 kVA: 50 dB.
 - 3. 151-300 kVA: 55 dB.
 - 4. 301-500 kVA: 60 dB.

- J. Basic Impulse Level: 10 kV
- K. Ground core and coil assembly to enclosure by means of visible flexible copper grounding strap sized to meet UL and NEMA standards.
- L. Mounting: As scheduled.
- M. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- N. Enclosure: NEMA ST 20, as indicated on Drawings. Furnish lifting eyes or brackets.
- O. Isolate core and coil from enclosure using vibration-absorbing mounts.
- P. Nameplate: Include transformer connection data.

2.02 SOURCE QUALITY CONTROL

- A. Production test each unit according to NEMA ST20.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify mounting supports are properly sized and located including concealed bracing in walls.

3.02 EXISTING WORK

- A. Disconnect and remove abandoned transformers.
- B. Maintain access and adequate ventilation to existing transformers and other installations remaining active and requiring access and ventilation. Modify installation or provide access panel or ventilation grilles.
- C. Clean and repair existing transformers to remain or to be reinstalled.

3.03 INSTALLATION

- A. Set transformer plumb and level.
- B. Use flexible conduit, in accordance with Section 26 05 33, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure below core.
- C. Support transformers in accordance with Section 26 05 29.
 - 1. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by manufacturer.

2. Mount floor-mounted transformers on vibration isolating pads suitable for isolating transformer noise from building structure.
 3. Mount suspended transformers on framing strut channels supported from building structure with threaded loads.
- D. Install grounding and bonding in accordance with Section 26 05 26.
- E. Provide sufficient space around transformer for cooling as recommended by manufacturer.

3.04 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Check for damage and tighten connections prior to energizing transformer.

3.05 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 26 24 16 – PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Distribution and branch circuit panelboards.

1.02 REFERENCE STANDARDS

A. National Electrical Manufacturers Association:

1. NEMA PB 1 - Panelboards.
2. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

B. National Fire Protection Association:

1. NFPA 70 - National Electrical Code.

C. Underwriters Laboratories Inc.:

1. UL 50 - Cabinets and Boxes.
2. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
3. UL 1283 - Electromagnetic Interference Filters.
4. UL 1449 - Transient Voltage Surge Suppressors.
5. UL 1699 - Arc-Fault Circuit Interrupters.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.**
- B. Product Data: Submit catalog data showing specified features of standard products.**
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.**
- D. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.**

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.05 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance products.

1.06 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years of experience.

PART 2 PRODUCTS

2.01 PANELBOARDS

- A. Acceptable Manufacturer List: Manufacturers are listed alphabetically:
 - 1. Eaton/Cutler-Hammer.
 - 2. ABB/General Electric.
 - 3. Schneider Electric/Square D.
- B. Substitution Limitations:
 - 1. Section 01 60 00 - Product Requirements: Requirements for substitutions for other manufacturers and products.
- C. Description: NEMA PB 1, panelboard.
- D. Operation:
 - 1. Service Conditions:
 - a. Temperature: <105 degrees F
 - b. Altitude: <6000 feet above sea level.
 - 2. Minimum integrated short circuit rating: as scheduled.
- E. Materials:
 - 1. Panelboard Bus: Aluminum, current carrying components, ratings as indicated on

Drawings. Furnish copper ground bus in each panelboard.

2. Fusible Switch Assemblies: NEMA KS 1, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Furnish interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses unless otherwise scheduled.
3. Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide electronic trip units when specifically scheduled in lieu of thermal type. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
4. Molded Case Circuit Breakers with Current Limiters: UL 489, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole. Provide electronic trip units when specifically scheduled in lieu of thermal type.
5. Current Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral overcurrent and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
6. Circuit Breaker Accessories: Trip units and auxiliary switches as scheduled.
7. Enclosure: NEMA PB 1, Type as scheduled.
8. Cabinet Front: Surface hinged trim type, fastened with screws.
9. Contractor shall determine feed arrangement, top or bottom, to match installation. Where specific feed arrangements are shown on the drawings, the contractor shall adhere to those requirements.
10. Furnish circuit directory inside door.

F. Finishes:

1. Covers, trim and doors: Manufacturer's standard gray enamel. Provide full height side-hinged trim type covers. Door-in-door type construction is not acceptable.
2. Enclosure: Galvanized.

2.02 ELECTRONIC GRADE PANELBOARD

A. Description:

1. Integral Surge Suppressor: Component recognized in accordance with UL 1449 and UL 1283.
2. Panelboard: UL 67 listed and TVSS device UL 1449 Component Recognized. TVSS device meets UL 1449. Furnish panelboard markings with clamp voltage at TVSS terminals and clamp voltage at panelboard line terminals.

B. Performance:

1. Integral Surge Suppressers:

a. Meet or exceed the following criteria:

- 1) Maximum single impulse current rating 80 kA, 120 kA, 160 kA, or 200 kA as scheduled for each phase.
- 2) Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 Category C transients without failure or degradation.
- 3) Clamping voltage not exceeding the following:

Voltage	L-N	N-G	L-G
208Y/120	500 V	500 V	500 V
480Y/277	1000 V	1000 V	1000 V

C. Fabrication:

1. Integral Surge Suppressor:

- a. Furnish copper bus bars for surge current path.
- b. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.
- c. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
- d. Furnish response time no greater than five nanoseconds for individual protection modes.
- e. Designed to withstand maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.
- f. Furnish visible indication of proper suppressor connection and operation. Lights indicate operable phase and module.
- g. Furnish minimum EMI/RFI filtering of 34 dB at 100 kHz with insertion loss ratio of 50: 1 using Mil Std. 220A methodology.

2. Panelboards:

- a. Furnish one circuit breaker, rating as recommended by manufacturer with appropriate number of poles, as dedicated disconnect for TVSS.
- b. Furnish 200 percent rated neutral assembly with aluminum neutral bus.
- c. Furnish with insulated ground bus and non-insulated equipment grounding bus.
- d. Remainder of specification requirements shall be per Article 2.1.

2.03 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Testing, inspection and analysis requirements.

- B. Independently test integral surge suppressors with category C3 high exposure waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panelboards and load centers plumb.
- B. Install recessed panelboards flush with wall finishes.
- C. Height: Where height of panelboard permits, 6' above finished floor or working surface. Otherwise, mount higher but to remain in compliance with NEC Article 404.8(A) requirements.
- D. Install filler plates for unused spaces in panelboards.
- E. Provide typed circuit directory for each branch circuit panelboard. Identify each circuit as to its clear, evident and specific purpose of use.
- F. Install engraved plastic nameplates in accordance with Section 26 05 53.
- G. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 3 empty 1 inch (DN27). Identify each as SPARE.
- H. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.02 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

3.03 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Measure and record steady state load currents at each panelboard feeder. Submit results to Engineer as part of close-out documents.

3.04 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean existing panelboards [and load centers] to remain or to be reinstalled.

END OF SECTION

SECTION 26 28 13 – 250 & 600 VOLT FUSES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes 250- and 600-volt fuses and spare fuse cabinet.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit data sheets showing electrical characteristics, including time-current curves.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual sizes, ratings and locations of fuses.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years of experience.

1.06 MAINTENANCE MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two fuse pullers.

1.07 MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish three spare fuses of each class, size and rating installed.

PART 2 PRODUCTS

2.01 FUSES

- A. Manufacturers:

1. Bussman.
 2. Littlefuse.
 3. Shawmut.
 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Dimensions and Performance: NEMA FU 1, class as specified or as indicated on Drawings.
- C. Voltage: Rating suitable for circuit phase-to-phase voltage.
- D. Interrupting Rating for all Fuses: 200,000 rms amperes minimum.
- 2.02 CLASS RK1 FUSES
- A. Bussman Type LPN-RK__SP (250V), LPS-RK__SP (600V) or equivalent
 - B. Dimensions and Performance: UL Class RK1, NEMA FU 1, current limiting.
 - C. Time Delay: 10 seconds minimum at 500% rated current.
 - D. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.03 CLASS RK5 FUSES
- A. Bussman Type FRN-R (250V), FRS-R (600V), or equivalent
 - B. Dimensions and Performance: UL Class RK1, NEMA FU 1, moderate current limiting.
 - C. Time Delay: 10 seconds minimum at 500% rated current.
 - D. Voltage: Rating suitable for circuit phase-to-phase voltage.
- 2.04 CLASS L (TIME DELAY) FUSES
- A. Bussman Type KRP-C__SP or equivalent
 - B. Construction: silver links with sand filler.
 - C. Dimensions and Performance: UL Class L, NEMA FU 1.
 - D. Time Delay: 4 seconds minimum at 500% rated current.
 - E. Interrupting Rating: 300,000 RMS symmetrical.
- 2.05 CLASS J (TIME DELAY) FUSES
- A. Bussman Type LPJ__SP, or equivalent

- B. Time Delay: 10 seconds minimum at 500% rated current.
- C. Dimensions and Performance: UL Class J, NEMA FU 1.
- D. Interrupting Rating: 200,000 RMS symmetrical minimum.

PART 3 EXECUTION

3.01 EXISTING WORK

- A. Remove fuses from abandoned circuits.
- B. Maintain access to existing fuses and other installations remaining active and requiring access. Modify installation or provide access panel.

3.02 INSTALLATION

- A. Install fuse with label oriented so manufacturer, type and size are easily read.

END OF SECTION

SECTION 26 28 16 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes fusible switches, non-fusible switches, and molded case and insulated case circuit breakers in individual enclosures.
- B. Related Sections:
 - 1. Section 26 28 13 - Fuses.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 3. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit switch ratings and enclosure dimensions.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed switches and circuit breakers with ratings of installed fuses.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section.

PART 2 PRODUCTS

2.01 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. ABB/GE Electrical.
 - 2. Eaton/Cutler Hammer.

3. Schneider Electric/Square D.
 4. Substitutions: Section 01 60 00 - Product Requirements
- B. Product Description: NEMA KS 1, heavy-duty enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
- D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R or 4 as noted on plans.
- E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- F. Furnish switches with entirely copper current carrying parts.

2.02 NON-FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
1. ABB/GE Electrical.
 2. Eaton/Cutler Hammer.
 3. Schneider Electric/Square D.
 4. Substitutions: Section 01 60 00 - Product Requirements
- B. Product Description: NEMA KS 1, heavy-duty enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R or 4 as noted on plans.
- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Furnish switches with entirely copper current carrying parts.

2.03 SWITCH RATINGS

- A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

- B. Short Circuit Current Rating: UL listed for 200,000 rms symmetrical amperes when used with or protected by Class R or Class J fuses (30-600 ampere switches employing appropriate fuse rejection schemes). 200,000 rms symmetrical amperes when used with or protected by Class L fuses (800-1200 ampere).

2.04 MOLDED CASE CIRCUIT BREAKER

- A. Manufacturers:
 - 1. ABB/GE Electrical.
 - 2. Eaton/Cutler Hammer.
 - 3. Schneider Electric/Square D.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: Enclosed, molded-case circuit breaker conforming to NEMA AB 1, suitable for use as service entrance equipment where applied.
- C. Service Conditions:
 - 1. Temperature: 104 degrees F maximum.
 - 2. Altitude: 6,000 feet maximum.
- D. Field-Adjustable Trip Circuit Breaker: Circuit breakers with frame sizes 200 amperes and larger have mechanism for adjustment as noted on Drawings.
- E. Current Limiting Circuit Breaker: Circuit breaker indicated as current-limiting have automatically-resetting current limiting elements in each pole. Let-through Current and Energy: Less than permitted for same size Class RK-5 fuse.
- F. Solid-State Circuit Breaker: Electronic sensing, timing, and tripping circuits for adjustable current settings; and delays as noted on Drawings.
- G. Current Limiter: Designed for application with molded case circuit breaker.
 - 1. Coordinate limiter size with trip rating of circuit breaker to prevent nuisance tripping and to achieve interrupting current rating specified for circuit breaker.
 - 2. Interlocks trip circuit breaker and prevent closing circuit breaker when limiter compartment cover is removed or when one or more limiter is not in place or has operated.
- H. Accessories: As indicated on Drawings. Conform to NEMA AB 1. Typical devices include breaker locks, pad lock provisions, auxiliary switch, shunt-trip operators, and others as indicated.
- I. Enclosure: NEMA AB 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.

- 2. Exterior Locations: Type 3R or 4 or as noted on Drawings.
- J. Service Entrance: Circuit breakers identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.

PART 3 EXECUTION

3.01 EXISTING WORK

- A. Disconnect and remove abandoned enclosed switches and circuit breakers.
- B. Maintain access to existing enclosed switches and circuit breakers and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed switches to remain or to be reinstalled.

3.02 INSTALLATION

- A. Install enclosed switches and circuit breakers plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet to operating handle.
- C. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- D. Install engraved plastic nameplates in accordance with Section 26 05 53.
- E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.03 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing and adjusting.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

3.04 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust trip settings to coordinate circuit breakers with other overcurrent protective devices in circuit.
- C. Adjust trip settings to provide adequate protection from overcurrent and fault currents

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END OF SECTION

SECTION 26 28 26 – ENCLOSED TRANSFER SWITCHES

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes transfer switches in individual enclosures.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
- B. Underwriters Laboratories Inc.:
 - 1. UL 1008 - Transfer Switch Equipment.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions and enclosure details.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed transfer switches.
- C. Operation and Maintenance Data: Submit routine preventative maintenance and lubrication schedule. List special tools, maintenance materials, and replacement parts.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years experience with service facilities within 100 miles of Project.
- B. Supplier: Authorized distributor of specified manufacturer with minimum five years of documented experience.

1.06 MAINTENANCE SERVICE

- A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of transfer switches for two years from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers are listed alphabetically below:
 - 1. ASCO
 - 2. Cummins
 - 3. Kohler.
 - 4. Substitutions: Under provisions of Section 01 60 00.

2.02 PRODUCT DESCRIPTION – AUTOMATIC TRANSFER SWITCHES

- A. NEMA ICS 10, automatic transfer switch.
- B. Configuration: Electrically operated, mechanically held transfer switch.

2.03 RATINGS AND FEATURES – AUTOMATIC TRANSFER SWITCHES

- A. All project specific performance requirements shall be in accordance with schedule titled "AUTOMATIC TRANSFER SWITCH SCHEDULE."
- B. Withstand Current Rating: 65,000 rms symmetrical amperes when used with a UL 489 listed molded case circuit breaker, or 200,000 rms symmetrical amperes when used with a Class J, K1 or L current limiting fuse.
- C. Service Conditions: NEMA ICS 10.
 - 1. Temperature: 105 degrees F maximum.
 - 2. Altitude: 3,300 maximum feet (1000 m) above sea level.
- D. Product Features:
 - 1. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, switch position.
 - 2. Test Switch: Mount in cover of enclosure to simulate failure of normal source.
 - 3. Test Mode Switch: Mount in cover of enclosure to inhibit or allow transfer of load to alternate source during engine exercising period
 - 4. Return to Normal Switch: Mount in cover of enclosure to initiate transfer from alternate source to normal source.
 - 5. Engine Switch: Mount in cover of enclosure. Provide LOCKOUT, NORMAL AND RUN positions.
 - 6. Transfer Switch Auxiliary Contacts: 2 normally open; 2 normally closed.

7. Normal Source Monitor: Monitor each phase of normal source voltage and frequency; initiate transfer when voltage or frequency falls beyond limits scheduled on the plans.
8. Alternate Source Monitor: Monitor each phase of alternate source voltage and frequency; inhibit re-transfer voltage or frequency is below the minimum limits scheduled on the plans.
9. Where scheduled, provide programmed transition to allow transfer switch to be delayed in the neutral position between normal and alternate sources.
10. Switched Neutral: When scheduled, switched neutrals shall utilize non-overlapping contacts.
11. Automatic Sequence of Operation: Provide adjustable time delays as follow:
 - a. TDES – Time Delay Engine Start: Time delay before engine start after sensing of under voltage/frequency by normal source monitor.
 - b. TDNE – Time Delay Normal to Emergency (Transfer): Time delay after alternate source stabilizes before beginning transfer to alternate source.
 - c. TDPT: Time Delay Programmed Transition: Time delay in neutral position between normal and alternate sources during either transfer or retransfer.
 - d. TDEN – Time Delay Emergency to Normal (Re-transfer): Time delay after normal source stabilizes before beginning re-transfer to normal; bypass time delay in event of alternate source failure.
 - e. TDEC – Time Delay Engine Cooling: Time delay for unloaded engine operation after re-transfer to normal.
 - f. TDPT – Time Delay Pre-Transfer Signal (when scheduled): Time delay in advance of normal to alternate transfers during tests, or any retransfers from alternate to normal.
12. Engine Exerciser: Bypass exerciser control when normal source fails during exercising period.
13. Enclosure: Enclosure: NEMA enclosure, type as scheduled
14. Finish: Manufacturer's standard enamel.
15. When switch is scheduled to be provided with bypass/isolation capability, provide with the following additional features.
 - a. Product Description: NEMA ICS 10, automatic transfer switch with manual bypass switch.
 - b. Configuration: Drawout type electrically-operated, mechanically-held transfer switch with manually-operated CONNECTED, TEST AND DISCONNECTED drawout positions, and with mechanically operated, mechanically held transfer switch connected to bypass automatic switch in both NORMAL and EMERGENCY positions.
 - c. Bypass Switch Ratings: Match automatic transfer switch for electrical ratings.

- d. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, automatic SWITCH POSITION, NORMAL BYPASS and ALTERNATE SOURCE BYPASS.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install housekeeping pads.
- B. Install engraved plastic nameplates in accordance with Section 26 05 53.

3.02 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.

3.03 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 - Quality Requirements: Manufacturers' field services.
- B. Check out transfer switch connections and operations and place in service.

3.04 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Adjust control and sensing devices to achieve specified sequence of operation.

3.05 DEMONSTRATION AND TRAINING

- A. Demonstrate operation of transfer switch in normal, emergency modes, and bypass (if applicable) modes.

END OF SECTION

SECTION 26 29 13 – MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes manual and magnetic motor controllers in individual enclosures.
- B. Related Sections:
 - 1. Section 26 28 13 – 250 & 600 Volt Fuses.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
 - 5. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions and enclosure details.
- C. Test Reports: Indicate field test and inspection procedures and test results.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit Replacement parts list for controllers.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years of experience.

1.06 COORDINATION WITH OTHER TRADES

- A. Equipment:

1. All building utility motors such as fans, pumps, overhead doors, etc., together with certain "controlling equipment" for same, except motor starters and related apparatus, will be furnished under other sections of the specifications and delivered to the building site unless specifically noted otherwise. The above mentioned "controlling equipment" pertains to electrical thermostats, electro-pneumatic and pneumatic-electric and detection devices, or any other device not purely electrically operating in nature.
2. The electrical trade shall set and connect all specified starting equipment, install all power conduits and wiring and shall furnish and make all connections from starting equipment to motors as required to leave the apparatus in running condition.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers

1. Eaton/Cutler Hammer.
2. ABB/General Electric.
3. Schneider Electric/Square D.
4. Substitutions: Section 01 60 00 - Product Requirements.

2.02 MANUAL MOTOR CONTROLLER

- A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller with overload element, red pilot light, NO and NC auxiliary contact, and toggle operator lockable in off position.
- B. Enclosure: NEMA ICS 6, Type 1.

2.03 FRACTIONAL-HORSEPOWER MANUAL CONTROLLER

- A. Product Description: NEMA ICS 2, AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, and toggle operator lockable in off position.
- B. Enclosure: NEMA ICS 6, Type 1.

2.04 MOTOR STARTING SWITCH

- A. Product Description: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with toggle operator lockable in off position. Furnish without thermal overloads.
- B. Enclosure: NEMA ICS 6, Type 1.

2.05 FULL-VOLTAGE NON-REVERSING CONTROLLERS

- A. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower.
- B. Control Voltage: 120 volts, 60 Hertz unless otherwise scheduled or noted on the Drawings.
- C. Overload Relay: NEMA ICS 2; melting alloy or solid-state type only. Bi-metallic-type elements are not acceptable.
- D. Product Features:
 - 1. Auxiliary Contacts: NEMA ICS 2, 2 each normally open and closed field convertible contacts in addition to seal-in contact.
 - 2. Cover Mounted Pilot Devices: NEMA ICS 5, standard duty type.
 - 3. Pilot Device Contacts: NEMA ICS 5, Form Z.
 - 4. Indicating Lights: LED type.
 - 5. Selector Switches: Rotary type, Hand-Off-Auto unless noted otherwise.
 - 6. Relays: NEMA ICS 2.
 - 7. Control Power Transformers: 120 volt secondary. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- E. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using a fusible or non-fusible switch as scheduled or as noted on the Drawings, conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.
- F. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R or 4 as noted on plans.

2.06 TWO-SPEED CONTROLLERS

- A. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Include integral time delay transition between SLOW and FAST speeds. Comply with Part 2 requirements of specification section
- B. Control Voltage: 120 volts, 60 Hertz.
- C. Product Features:
 - 1. Auxiliary Contacts: NEMA ICS 2, 1 each normally open and closed for each speed, field convertible contacts in addition to seal-in contact.
 - 2. Cover-Mounted Pilot Devices: NEMA ICS 5, standard type.

3. Pilot Device Contacts: NEMA ICS 5, Form Z.
 4. Indicating Lights: LED type. Provide separate indicators for high, low and off operation.
 5. Selector Switches: Rotary type with high-low-off-auto positions.
 6. Relays: NEMA ICS 2.
 7. Control Power Transformers: 120 volt secondary, 50 VA minimum, in each motor starter. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- D. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.
- E. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
1. Interior Dry Locations: Type 1.
 2. Exterior Locations: Type 3R or 4 as noted on Drawings.

2.07 FULL-VOLTAGE REVERSING CONTROLLERS

- A. Product Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation.
- B. Control Voltage: 120 volts, 60 Hertz.
- C. Overload Relay: NEMA ICS 2; solid-state.
- D. Product Features:
1. Auxiliary Contacts: NEMA ICS 2, 2 each normally open and closed field convertible contacts for each rotation direction in addition to seal-in contact.
 2. Cover Mounted Pilot Devices: NEMA ICS 5, standard type.
 3. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
 4. Pushbuttons: Unguarded type.
 5. Indicating Lights: LED type.
 6. Selector Switches: Two rotary-types.
 7. Relays: NEMA ICS 2.
 8. Control Power Transformers: 50 va., 120 volt secondary. Furnish fused primary

and secondary, and bond unfused leg of secondary to enclosure.

- E. Combination Controllers: Combine motor controllers with disconnect in common enclosure, using thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.
- F. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R or 4 as noted on plans.

PART 3 EXECUTION

3.01 EXISTING WORK

- A. Disconnect and remove abandoned enclosed motor controllers.
- B. Maintain access to existing enclosed motor controllers and other installations to remain active and to require access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed motor controllers to remain or to be reinstalled.

3.02 INSTALLATION

- A. Install enclosed controllers plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet operating handle.
- C. Install fuses for fusible switches. Refer to Section 26 28 13 for product requirements.
- D. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- E. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.
- F. Neatly type label and place inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.

3.03 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements, 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Verify correct rotation for all three phase motors.
- C. Measure amperage of all motors on startup, compare to nameplate data, inform A/E of all out-of-range readings.

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END OF SECTION

SECTION 26 29 16 – ENCLOSED CONTACTORS

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes enclosed contactors for lighting and general purposes.

1.02 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 2. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 3. NEMA ICS 6 - Industrial Control and Systems: Enclosures.

1.03 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Product Data: Submit dimensions, size, voltage ratings and current ratings.

1.04 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for replacing and maintaining coil and contacts.

1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years of experience.

PART 2 PRODUCTS

2.01 GENERAL PURPOSE CONTACTORS

- A. Manufacturers:
 - 1. Eaton.
 - 2. ABB.
 - 3. Square D.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.

- B. Product Description: NEMA ICS 2, AC general purpose magnetic contactor.
- C. Coil Operating Voltage: 120 volts, 60 hertz, unless otherwise scheduled.
- D. Poles: To match circuit configuration and control function.
- E. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R or as scheduled.

2.02 LIGHTING CONTACTORS

- A. Manufacturers:
 - 1. Eaton.
 - 2. ABB.
 - 3. Square D.
 - 4. Substitutions: Section 01 60 00 - Product Requirements.
- B. Product Description: NEMA ICS 2, magnetic lighting contactor.
- C. Coil Operating Voltage: 120 volts, 60 hertz, unless otherwise scheduled.
- D. Poles: As scheduled.
- E. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.
- F. Accessories:
 - 1. Cover-Mounted Pilot Devices: NEMA ICS 5, standard-duty type with Form Z contacts.
 - 2. Pushbutton: ON/OFF function, with unguarded configuration.
 - 3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
 - 4. Indicating Light: GREEN lens, led lamp.
 - 5. Auxiliary Contacts: One normally open and one normally closed in addition to seal-in contact.
 - 6. Relays: NEMA ICS 2.
 - 7. Control Power Transformers: 120 volt secondary. Furnish fused primary, fused

secondary and bond unfused leg of secondary to enclosure.

- G. Combination Contactors: Combine contactors with thermal magnetic circuit breaker conforming to NEMA AB 1, with integral thermal and instantaneous magnetic trip in each pole.
- H. Enclosure: NEMA ICS 6, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.

PART 3 EXECUTION

3.01 EXISTING WORK

- A. Disconnect abandoned enclosed contactors and remove abandoned enclosed contactors.
- B. Maintain access to existing enclosed contactors and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed contactors to remain or to be reinstalled.

3.02 INSTALLATION

- A. Install enclosed contactors as indicated on Drawings and in accordance with NECA "Standard of Installation."
- B. Install enclosed contactors plumb. Provide supports in accordance with Section 26 05 29.
- C. Height: 5 feet to operating handle.
- D. Install fuses for fusible switches. Refer to Section 26 28 13 for product requirements.
- E. Install engraved plastic nameplates. Refer to Section 26 05 53 for product requirements and location.

3.03 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.16.1.

END OF SECTION

SECTION 26 32 13 – PACKAGED ENGINE GENERATOR SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged engine generator set.
- B. Exhaust silencer and fittings.
- C. Batteries and charger.
- D. Miscellaneous accessories.

1.02 RELATED SECTIONS

- A. Section 26 36 23 – Automatic Transfer Switches.

1.03 REFERENCES

- A. NEMA AB1 - Molded Case Circuit Breakers.
- B. NEMA MG1 - Motors and Generators.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum.)
- D. NFPA 30 – Flammable and Combustible Liquids Code.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 110 – Emergency and Standby Power Systems.

1.04 SYSTEM DESCRIPTION

- A. Description: Engine generator assembly and accessories to provide source of power for Level 1 applications in accordance with NFPA 110.
- B. Capable of continuous standby operation at site conditions while meeting all performance requirements as stated on the drawings and as described in this specification.

1.05 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings:
 - 1. Provide electrical diagrams including schematic and interconnection diagrams for all components. Indicate electrical characteristics and all connection requirements.
 - 2. Provide Drawings of each major component assembly and accessory.

3. In addition to component Drawings, submit plan and elevation views with overall dimensions for a complete assembly of all major components. Indicate rough in dimensions for all connection points and weight bearing points on the overall views. Submittals consisting of individual component Drawings, without overall plans and elevations for the complete unit as finally assembled, will be rejected.
- C. Product Data: Provide data showing the following.
1. Weights.
 2. Fuel consumption at full load.
 3. Free field sound pressure levels in dBA at eight lateral points 3 meters from center of unit.
 4. Exhaust silencer data.
 5. Ventilation air requirements.
 6. Combustion air requirements.
 7. Radiated heat in BTU per minute
 8. Exhaust flow rate and temperature.
 9. Radiator fan capabilities in CFM with 0.5 in water total flow restriction.
 10. Provide data sufficient to determine maximum instantaneous voltage drop for various inrush KVA's, up to and including the maximum inrush KVA scheduled on the plans. The data shall include the combined effects of both subtransient reactance and torque matching features of the governor system. Instantaneous voltage dip shall be determined in accordance with the definition in the NEMA MG1 Standard.
 11. Provide the maximum inrush KVA for which the excitation support system and engine will provide sustained recovery, to 90 percent of rated output voltage within 250 msec, while remaining within a +/- 10 percent of rated voltage band.
 12. Provide data showing that maximum alternator winding temperature rise will not exceed the value specified in Paragraph 2.05D.
 13. Provide a certification from the manufacturer certifying that the maximum alternator winding operating temperature will meet the requirements specified in Paragraph 2.05E. Note that a factory certification is required – statements from the supplier are not acceptable.
 14. Prototype Testing Summary Report. Indicate results of performance testing. Prototype tests shall have been done on a complete and functional unit, component level type tests will not substitute for this requirement. The prototype test report shall indicate the engine model number and alternator model number of the prototype unit on which the report was based. Provide justification for

extrapolation of prototype test results if model number of proposed engine or alternator do not match those of the prototype test.

- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation and starting of Product.
- E. Manufacturer's Certificate: Certify that products meet or exceed all specified requirements, including confirmation that the manufacturer has done a line-by-line review of this entire specification section.
- F. Manufacturer's Field Reports: Indicate procedures and findings. Submit to engineer for review within 10 days of completion of testing.

1.06 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Section 01 70 00.
- B. Operation Data: Include instructions for normal operation.
- C. Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine, alternator, and all accessories, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.07 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 110.

1.08 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum twenty years of documented experience, and with service facilities within 100 miles of project.
- B. Supplier: Authorized distributor of specified manufacturer with minimum five years of documented experience.

1.09 WARRANTY

- A. Furnish a two-year manufacturer warranty.

1.10 MAINTENANCE SERVICE

- A. Furnish service and maintenance of engine generator through and including the second annual maintenance and inspection, from Date of Substantial Completion. Provide all recommended quarterly, semi-annual, and annual maintenance activities as recommended in Table A-6-3.1(a) of NFPA 110. Provide cost breakout for annual maintenance activities.

1.11 REGULATORY REQUIREMENTS

- A. Conform to requirements of the Reference Standards.

- B. Furnish products listed and classified by Underwriters Laboratories as suitable for purpose specified and indicated.
- C. Comply with all emission standards for continuous standby service applicable to the project site. Provide a unit complying with both current standards and those if any scheduled for implementation within one year of bid date.

1.12 PRE-INSTALLATION CONFERENCE

- A. Convene one week prior to commencing work of this Section, under provisions of Section 01 30 00.

1.13 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Section 01 60 00.
- B. Accept unit on site on skids. Inspect for damage.
- C. Protect equipment from dirt and moisture by securely wrapping in heavy plastic.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Caterpillar.
- B. Cummins.
- C. Generac.
- D. Kohler.
- E. Substitutions: Under provisions of Section 01 60 00.

2.02 SERVICE CONDITIONS

- A. Elevation: 3,300 feet maximum unless noted otherwise on the drawings.
- B. Temperature: Outdoor units: 110 degrees F ambient dry bulb temperature measured outside of engine housing at air intake. Indoor units: 125 degrees F room temperature, measured at alternator air intake screen with generator set running at full load.

2.03 PERFORMANCE

- A. All project-specific performance requirements shall be in accordance with schedule titled "ENGINE GENERATOR SET SCHEDULE."
- B. The system shall be capable of continuous standby operation at site conditions while operating the maximum scheduled load.

- C. The installed system shall be capable of successfully starting and running the scheduled loads.
- D. The system shall meet all scheduled performance criteria.
- E. The system shall comply with all other requirements for this specification.
- F. The engine-generator set shall be capable of single step load pick up of 100 percent nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature, in accordance with NFPA 110-1993, 5-13.2.6.
- G. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 1.0 percent.
- H. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Frequency drop and skew rate during starting any scheduled load step, or during restarting of cyclical loads, shall not exceed the values scheduled on the plans and shall return to steady state within two seconds. For purposes of determining compliance with this requirement, all cyclical loads scheduled shall be assumed to be restarted simultaneously.
- I. Instantaneous voltage drop shall not exceed the value scheduled on the plans when starting any scheduled load step, or when restarting individual cyclical loads, shall not exceed the value scheduled on the plans. The maximum instantaneous voltage drop shall be measured as specified and defined in the NEMA MG1 standard, and shall include the effects of both subtransient reactance and torque matching features of the governor system (torque rolloff).
- J. The excitation system and engine shall be capable of sustained recovery to 90 percent of rated output voltage while supplying the greater of a) the maximum inrush KVA for any load step scheduled on the plans, or b) the sum of the scheduled inrush KVA's of all cyclical loads, and for a duration sufficient to successfully start the loads.
- K. The alternator shall produce an AC voltage waveform, with not more than 5 percent total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3 percent in any single harmonic. Telephone influence factor shall be less than 40.

2.04 ENGINE

- a. Engine speed: 1800 rpm.
- b. Governor: Electronic isochronous type, as manufactured by Barber-Coleman or Woodward.
- c. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine overcrank. Limits as selected by manufacturer. Alarm sensors and limits shall match control panel functions, providing all devices necessary for control panel displayed parameters.

- d. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Include remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.
- e. Engine Jacket Heaters: Provide thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F (32 degrees C) at ambient conditions 10 degrees F below ASHRAE 99 percent winter design conditions for the site, and suitable for operation at the voltage as scheduled.
- F. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature while operating in the Service Conditions as specified under Paragraph 2.03 above and with an external air flow restriction of 0.5 inches of water (1.25 Pa) maximum.
- G. Engine Accessories: lube oil filter, intake air filter, lube oil cooler, gear-driven water pump. Include fuel pressure gauge, water temperature gauge, and lube oil pressure gauge on engine/generator control panel.
- H. Mounting: Provide unit with suitable vibration isolation and mount on structural steel base.

2.05 ALTERNATOR

- A. Alternator: NEMA MG1, three-phase, four-pole, 2/3 pitch, reconnectable brushless synchronous generator with brushless exciter.
- B. Rating: Oversized as required to meet all specified and scheduled performance requirements.
- C. Insulation Class: H, vacuum pressure impregnated.
- D. Rated Winding Temperature Rise: The rated winding temperature rise shall not exceed 105° C when operating a resistive load at the alternator nameplate rating.
- E. Actual Winding Operating Temperature: The maximum winding operating temperature, including the heating effects of harmonic currents and as determined by the resistance method, shall not exceed 165 degrees C while operating the loads scheduled on the Drawings under the Service Conditions specified in Paragraph 2.02.
- F. Enclosure: NEMA MG1, open drip-proof.
- G. Voltage Regulation: Include generator-mounted volts per hertz exciter-regulator to match engine and generator characteristics, and to meet the Performance Requirements in Paragraph 2.03. Include manual controls to adjust voltage droop, voltage level (plus or minus 5 percent) and voltage gain. Manufacturer's standard excitation system shall be provided. Voltage regulation shall be immune from misoperation due to load-induced voltage wave form distortion. A permanent magnet generator (PMG) shall provide excitation power to the automatic voltage regulator.

2.06 ACCESSORIES

- A. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions.
- B. Batteries: Heavy-duty, lead-acid storage batteries. Match battery voltage to starting system and capacity to engine requirements and size to provide three full cranking cycles. Include necessary cables.
- C. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.
- D. Battery Charger: Current limiting type designed to float at 2.17 volts per cell and equalize at 2.33 volts per cell. Include overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Mount within generator housing and provide with vibration isolation.
- E. Line Circuit Breaker(s): NEMA AB 1, UL Listed, 3P, molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole, sized in accordance with NFPA 70. Unit mount in enclosure to meet NEMA 250, Type 1 requirements.
- F. Engine-Generator Control Panel: NEMA Type 1 gasketed generator-mounted control panel enclosure with illuminated engine and generator controls and indicators. Include provision for padlock and the following equipment and features:
 - 1. Frequency Meter: 45-65 Hz. range.
 - 2. AC Output Voltmeter: 2 percent minimum accuracy, with phase selector switch.
 - 3. AC Output Ammeter: 2 percent minimum accuracy, with phase selector switch.
 - 4. Output voltage adjustment.
 - 5. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, overspeed, and overcrank.
 - 6. Engine start/stop selector switch.
 - 7. Engine running time meter.
 - 8. Oil pressure gauge.
 - 9. Water temperature gauge.
 - 10. Auxiliary Relay: 3PDT, to operate when engine runs, with contact terminals prewired to terminal strip.
 - 11. Additional visual indicators and alarms as required by NFPA 110.
 - 12. Remote Alarm Contacts: Pre-wire SPDT contacts to terminal strip for remote alarm functions required by NFPA 110.
- G. Remote Annunciator Panel: Surface-mounted panel with brushed stainless steel finish.

Provide audible and visible indicators and alarms required by NFPA 110. Include annunciation of position of each transfer switch, leak detection alarm, each other alarm point scheduled, and a minimum of four additional spare points.

- H. Provide manual emergency stop station per NFPA 110-3-5.5.6.
- I. Miscellaneous Heaters: Control panel heater, generator heater and battery heaters, all suitable for operation at 120 volts. All heaters shall be automatically disconnected when prime mover is running.
- J. Gas Regulators as specified shall be provided and shipped with the unit by the generator set manufacturer,
 - 1. Provide a primary regulator to be field mounted immediately adjacent to the packaged generator set. The primary regulator shall be capable of operating the generator under all load conditions with an nominal input pressure to the regulator of 8.5 psig and between 7 psig minimum to 10 psig maximum under transient conditions. Output pressure shall be adjusted to match the requirements of the engine mounted (secondary) regulator. Dynamic response characteristics of the regulator shall be such that after application of step or cyclical loads, operation of the generator set will return to steady-state conditions within 1 sec. Provide a suitable flexible connection for connecting the primary regulator to the secondary (engine mounted) regulator, and for connection of pilot line(s) if required. Include instructions for inter connecting the two regulators. Include in the instructions any critical lengths or routing to be maintained, location of pilot sensing line connections, and any other critical criteria which must be adhered to provide satisfactory performance.
 - 2. Provide manufacturer's standard secondary regulator, mounted to engine, to reduce pressure to final utilization pressure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.02 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 40 00.
- B. Provide full load test utilizing portable test bank, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown and return to normal. Demonstrate compliance with NFPA 110-1993, 5-13 "Installation Acceptance."
- C. Record in 5-minute intervals for the first 15 minutes and in 15-minute intervals thereafter during overall four-hour test:
 - 1. Kilowatts.

2. Amperes.
3. Voltage.
4. Coolant temperature.
5. Room temperature.
6. Frequency.
7. Oil pressure.

D. Test alarm and shutdown circuits by simulating conditions.

3.03 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems under provisions of Section 01 40 00.

3.04 ADJUSTING

A. Adjust work under provisions of Section 01 70 00.

B. Adjust generator output voltage and engine speed.

3.05 CLEANING

A. Clean work under provisions of Section 01 70 00.

B. Clean engine and generator surfaces. Replace oil and filters.

3.06 DEMONSTRATION

A. Provide systems demonstration under provisions of Section 01 70 00.

B. Describe loads connected to emergency system and restrictions for future load additions.

C. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency power.

END OF SECTION

SECTION 26 43 13 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. Section includes surge protective devices for:
 - 1. Service Entrance.
 - 2. Electronic grade panelboards.
 - 3. Special systems control and data terminals.
- B. Related sections:
 - 1. 26 24 16 – Panelboards for factory-installed SPDs.

1.03 DEFINITIONS

- A. ATS: Acceptance Testing Specifications.
- B. VPR: Voltage Protection Rating.
- C. SPD: Surge Protection Device.

1.04 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - 2. IEEE C62.41.1, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
 - 3. IEEE C62.42, IEEE Recommended Practice on Characterization of Surges in Low Voltage AC Power Circuits and test devices.
 - 4. IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment connected to Low Voltage AC Power Circuits.

1.05 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories.
- C. Product Certificates: For surge protection devices, signed by product manufacturer certifying compliance with the latest editions of the following standards:
 - 1. UL 1283, Electromagnetic Interference Filters.
 - 2. UL 1449, Surge Protective Devices.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports, including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Failed test results and corrective action taken to achieve requirements.
- F. Operation and Maintenance Data: For surge protection devices to include in emergency, operation, and maintenance manuals.
- G. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, dimensional requirements, and electrical performance of suppressors and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.07 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Construction Manager not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Construction Manager's written permission.
- B. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating RMS voltage for 480Y/277V and not less than 125 percent of nominal RMS voltage for 208Y/120V.
 - 2. Operating Temperature: 30 to 120 deg F.
 - 3. Humidity: 0 to 85 percent, noncondensing.
 - 3. Altitude: Less than 20,000 feet above sea level.

1.08 COORDINATION

- A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.09 WARRANTY

- A. Most manufacturers offer five-year extended warranties on their equipment. Some manufacturers of cord-connected, plug-in surge suppressors offer extended warranties that either repair or replace damaged equipment that is protected by the suppressor.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Substantial Completion.
- C. Warranty shall not be pro-rated and shall cover manufacturer defects and workmanship, plus any end-of-life electrical events including lightning.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advanced Protection Technologies, Inc.
 - 2. Current Technology, Inc.

3. Cutler-Hammer, Inc.; Eaton Corporation.
4. ABB/General Electric Company.
5. Intermatic, Inc.
6. LEA International.
7. Leviton Mfg. Company Inc.
8. Liebert Corporation; a division of Emerson.
9. Siemens Energy & Automation, Inc.
10. Square D; Schneider Electric.
11. United Power Corporation.
12. Zero Surge Inc.

2.02 SERVICE ENTRANCE SURGE PROTECTIVE DEVICE

A. Description:

1. Integral, factory-installed surge suppressor: Component recognized in accordance with UL 1449 and UL 1283.
2. Connection Means: Permanently wired.

B. Performance:

1. Meet or exceed the following criteria:
 - a. Minimum single impulse current rating 250 kA per mode, 500 kA per phase.
 - b. Capable of protecting against and surviving 3500 IEEE C62.41 Category C transients with less than 5% degradation of clamping voltage.
 - c. Voltage protection rating (VPR) not exceeding the following:

Voltage	L-N	N-G	L-G	L-L
208Y/120	800 V	800 V	800 V	1200 V
480Y/277	1200 V	1200 V	1200 V	2000 V

C. Fabrication:

1. Furnish copper bus bars for surge current path.
2. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.

3. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
 4. Furnish response time no greater than five nanoseconds for individual protection modes.
 5. Furnish visible indication of proper suppressor connection and operation. Lights indicate operable phase and module.
 6. Furnish minimum EMI/RFI filtering up to 60 dB from 10 kHz to 100 MHz with insertion loss ratio of 50:1 using MIL Std. 220A methodology.
 7. One set of electrically isolated Form C dry contacts, one normally open and one normally closed, for remote monitoring.
 8. Surge-event operations counter.
- D. The ANSI/UL 1449 nominal discharge current rating shall be a minimum of 20kA.
- E. SPD shall be UL labeled and Short Circuit rating shall be greater than that of the Switchboard and/or Panelboard being protected.
- F. SPD shall be UL labeled as Type 1, intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls.

2.03 PANELBOARD SURGE PROTECTIVE DEVICES

- A. Description:
1. Integral, factory-installed surge suppressor: Component recognized in accordance with UL 1449 and UL 1283.
- B. Performance:
1. Meet or exceed the following criteria:
 - a. Minimum single impulse current rating 50 kA per mode, 100 kA per phase.
 - b. Capable of protecting against and surviving 3500 IEEE C62.41 Category C transients with less than 5% degradation of clamping voltage.
 - c. Voltage protection rating (VPR) not exceeding the following:

Voltage	L-N	N-G	L-G	L-L
208Y/120	800 V	800 V	800 V	1200 V
480Y/277	1200 V	1200 V	1200 V	2000 V

- C. Fabrication:
1. Furnish copper bus bars for surge current path.

2. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.
 3. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
 4. Furnish response time no greater than five nanoseconds for individual protection modes.
 5. Furnish visible indication of proper suppressor connection and operation. Lights indicate operable phase and module.
 6. Furnish minimum EFI/RFI filtering up to 60 dB from 10 kHz to 100 MHz with insertion loss ratio of 50:1 using MIL Std. 220A methodology.
 7. One set of electrically isolated Form C dry contacts, one normally open and one normally closed, for remote monitoring.
 8. Surge-event operations counter.
- D. The ANSI/UL 1449 nominal discharge current rating shall be a minimum of 20kA.
- E. SPD shall be UL labeled and Short Circuit rating shall be greater than that of the Switchboard and/or Panelboard being protected.
- F. SPD shall be UL labeled as Type 1, intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls.

2.04 AUXILIARY PANEL SURGE PROTECTIVE DEVICES

- A. Description:
1. Surge Suppressor: Component recognized in accordance with UL 1449 and UL 1283.
- B. Performance:
1. Meet or exceed the following criteria:
 - a. Minimum single impulse current rating 50 kA per mode, 100 kA per phase.
 - b. Capable of protecting against and surviving 3500 IEEE C62.41 Category C transients with less than 5% degradation of clamping voltage.
 - c. Voltage protection rating (VPR) not exceeding the following:

Voltage	L-N	N-G	L-G	L-L
208Y/120	800 V	800 V	800 V	1200 V
480Y/277	1200 V	1200 V	1200 V	2000 V

C. Fabrication:

1. Furnish copper bus bars for surge current path.
2. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.
3. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
4. Furnish response time no greater than five nanoseconds for individual protection modes.
5. Furnish visible indication of proper suppressor connection and operation. Lights indicate operable phase and module.
6. Furnish minimum EMI/RFI filtering up to 60 dB from 10 kHz to 100 MHz with insertion loss ratio of 50:1 using MIL Std. 220A methodology.
7. One set of electrically isolated Form C dry contacts, one normally open and one normally closed, for remote monitoring.
8. Surge-event operations counter.

D. The ANSI/UL 1449 nominal discharge current rating shall be a minimum of 20kA.

E. SPD shall be UL labeled and Short Circuit rating shall be greater than that of the Switchboard and/or Panelboard being protected.

F. SPD shall be UL labeled as Type 1, intended for use without need for external or supplemental overcurrent controls. Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls.

2.05 SPECIAL SYSTEMS CONTROL AND DATA TERMINALS

A. Protectors for fire alarm, copper control, data, antenna, and telephone conductors entering the building from the outside shall be as recommended by the manufacturer for the type of line being protected.

2.06 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 EXECUTION

3.01 INSTALLATION OF SURGE PROTECTIVE DEVICES

A. Provide surge suppression for the incoming service at the switchboard or service entrance equipment.

- B. Provide surge suppression at the tele/data demark phone board or cabinet as close as possible to the incoming conduit and conductors. Provide surge suppression for all tele/data conductors that are run underground from one MDF/IDF to another.
- C. Provide surge suppression at all fire alarm panels that connect to any fire alarm panel or device with underground conductors.
- D. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.
- E. Install devices for distribution panelboards, branch circuit panelboards, auxiliary panels, or buses with conductors between surge protective device and points of attachment as short and straight as possible. The contractor shall twist the SPD input conductors together to reduce input conductor inductance. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- F. Install devices at service entrance on load side with ground lead bonded to service entrance ground. At Service Entrance or Transfer Switch, a UL approved disconnect switch shall be provided as a means of servicing disconnect if a 60 A breaker is not available.
- G. Provide minimum 30-amp multipole circuit breaker as a dedicated disconnect for suppressor at branch circuit and distribution panelboards, unless otherwise indicated.
- H. Installer may reasonably rearrange breaker locations to ensure shortest & straightest possible leads to SPDs per NEC 285.12
- I. Before energizing, installer shall verify service and separately derived system neutral to ground bonding jumpers per NEC.
- J. For surface mounted panelboards, associated surge protective device shall be surface mounted adjacent to the panelboard with user access. For recessed mounted panelboards, associated surge protective devices shall be mounted recessed adjacent to the panelboard with user access. Do not mount above 84 inches unless directed.
- K. For surge protective devices added to existing equipment in a separate enclosure, conductor size shall be #4 AWG minimum.

3.02 PLACING SYSTEM INTO SERVICE

- A. Do not energize or connect service entrance equipment or panelboards to their sources until surge protection devices are installed and connected.

3.03 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 - 1. After installing surge protective devices, test for compliance with requirements.
 - 2. Complete startup checks according to manufacturer's written instructions.

3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, Section 7.19. Certify compliance with test parameters.
 4. If the SPD led are not green, replace with new unit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect test, and adjust equipment installation, including connections. Report results in writing.
- C. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 26 51 16 – INTERIOR LIGHTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes interior luminaires, drivers and accessories.

1.02 SUBMITTALS

- A. Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.
- D. Samples: Submit two color chips 3 by 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.

1.03 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.

PART 2 PRODUCTS

2.01 INTERIOR LUMINAIRES

- A. Product Description: Complete interior luminaire assemblies, with features, options and accessories as scheduled on Drawings.
- B. Refer to Section 01 60 00 – Product Requirements for product options.

2.02 LED LIGHTING

- A. Luminaires
 1. The luminaire manufacturer shall be registered as a DOE Quality Advocate.
 2. Shall meet DOE's Energy Star or Design Light Consortium performance criteria.
 3. The luminaire manufacturer shall provide the manufacturer's name of the LED being used in the luminaire.
 4. Shall be UL or ETL listed and be furnished complete with LEDs and power supplies.
 5. LED light source packages, arrays or modules used in the luminaire shall be tested in accordance with LM-80 lumen depreciation test. Provide test results of

each unique package, array or module. The L70 rated life result shall be a minimum of 50,000 hours.

6. Shall be tested in accordance with LM-79-08 electrical and photometric measurements. Provide test results of each unique luminaire.
7. The CCT shall be 4000K unless otherwise approved. The CRI shall be ≥ 80 .
8. Each luminaire shall have a power factor ≥ 90 percent.
9. In instances where the LED sources are to be mounted directly into the architecture, such as installing a strip LED by using an adhesive tape, the LED manufacturer shall provide a recommended heat sink volume adequate to achieve rated life at L70.
10. Each luminaire shall carry a 3-year minimum product warranty covering failure of ALL electrical components.

B. Power Supplies

1. LED power supplies shall operate LEDs within the current limit specification of the manufacturer.
2. Shall operate from 60Hz input source and have input power factor >90 percent and a minimum efficiency of 70 percent at full rated load of the driver.
3. Shall have short circuit and overload protection.
4. Shall have a minimum starting temperature of 0 degrees F and a maximum case temperature rating of at least 70 degrees C.
5. Power supply output shall be regulated to ± 5 percent across published load range.
6. Shall have a Class A sound rating.
7. Shall comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47CFR part 15, non-consumer (Class A) for EMI/RFI.
8. Shall contain no PCBs.
9. Shall carry a 3-year minimum warranty from date of manufacturer against defects in material or workmanship, including a replacement, for operation at or below the maximum case temperature specification. (For LED lamps and internal power regulation components for defects resulting in a fixture lumen depreciation >30 percent.)
10. Dimmable power supplies shall allow the light output to be maintained at the lowest control setting (prior to off) without dropping out.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Support luminaires 2 x 2 foot size and larger independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place.
- I. Install wall-mounted luminaires at height as indicated on Drawings or as scheduled.
- J. Install accessories furnished with each luminaire.
- K. Connect luminaires to branch circuit outlets provided under Section 26 05 33 using 1/2" min. x 6'-0" max. flexible conduit, or type MC cable where allowed under other sections of this specification.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Install specified lamps in each luminaire.
- N. Interface with air handling accessories furnished and installed under Section 23 37 00.
- O. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.02 FIELD QUALITY CONTROL

- A. Section 01 40 00 – Quality Requirements and Section 01 70 00 – Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.03 ADJUSTING

- A. Section 01 70 00 – Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Aim and adjust luminaires [as indicated on Drawings].

3.04 CLEANING

- A. Section 01 70 00 – Execution and Closeout Requirements: Final cleaning.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.05 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 – Execution and Closeout Requirements: Protecting finished work.
- B. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION

SECTION 26 56 16 – EXTERIOR LIGHTING

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes exterior luminaires, poles and accessories.

1.02 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard Product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.
- D. Samples: Submit two color chips 3 x 3 inch in size illustrating luminaire finish color where indicated in luminaire schedule.
- E. Light Layout: Provide a computer-generated factory point to point foot-candle layout of the project for each area involved.

1.03 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years of experience.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

1.05 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

PART 2 PRODUCTS

2.01 LUMINAIRES

- A. Product Description: Complete exterior luminaire assemblies, with features, options and accessories as scheduled on Drawings.
- B. Refer to Section 01 60 00 - Product Requirements for product options.

2.02 LED LUMINAIRES

- A. LED Pole Luminaires

1. Construction: Single-piece die-cast aluminum housing has integral heat sink fins to optimize thermal management through conductive and convective cooling. The LED drivers are mounted in direct contact with the casting to promote low operating temperature and long life. Housing is completely sealed against moisture and environmental contaminants (IP65). Finish: Exterior parts are protected by a zinc-infused Super Durable TGIC thermoset powder coat finish. Minimum 3 mils thickness.
2. Optics: Precision-molded acrylic lenses are engineered for superior area lighting distribution, uniformity, and pole spacing. Light engine is standard 4000K zero upright and qualifies as a Nighttime Friendly™ product.
3. Electrical: High-efficacy LEDs mounted to a metal-core circuit board to maximize heat dissipation and promote long life (L87/100,000 hrs at 40°C). Class 1 electronic drivers have a power factor >90%, THD <20%, and an expected life of 100,000 hours with <1% failure rate.
4. Hardware: Stainless steel bolts fasten the mounting block securely to poles and walls.

B. LED Wall Luminaires

1. Construction: Two-piece die-cast aluminum housing has integral heat sink fins to optimize thermal management through conductive and convective cooling. The LED driver is mounted to the door to thermally isolate it from the light engines for low operating temperature and long life. Housing is completely sealed against moisture and environmental contaminants (IP65). Housing weep holes for wet location listing in the face-up orientation; this permits safe drainage while maintaining the luminaire's IP65 rating.
2. Finish: Exterior parts are protected by a zinc-infused Super Durable TGIC thermoset powder coat finish. Minimum 3 mils thickness.
3. Optics: Precision-molded proprietary acrylic lenses with photometric distributions tailored specifically to building mounted applications. Light engines are 4000K (70 min.CRI), and qualifies as a Nighttime Friendly™ product when not mounted under a canopy or similar covering.
4. Electrical: High-efficacy LEDs mounted to a metal-core circuit board to maximize heat dissipation and promote long life. Class 1 electronic driver has a power factor >90%, THD <20%, and has an expected life of 100,000 hours with <1% failure rate.
5. Hardware: Universal mounting plate with integral mounting support arms.

2.03 METAL POLES

A. Manufacturers:

3. Millerbernd.
4. Spaulding.

5. Valmont.
 - B. Substitutions: Section 01 60 00 - Product Requirements.
 - C. Material and Finish: Steel, Bronze Polyester Powder Coat finish, unless noted otherwise on fixture schedule.
 - D. Shape and Dimensions: Square straight, length per fixture schedule.
 - E. Base: Non-Breakaway type, provide with bolt covers.
 - F. Accessories:
 1. Anchor Bolts.
 2. Handhole.
 - G. Loading Capacity Ratings:
 1. Luminaire Weight: Per Luminaire Supplier
 2. Luminaire EPA: Per Luminaire Supplier
 3. Wind Load Design: 90 mph steady wind, 1.3 gust factor.

2.04 POLE FOUNDATIONS

- A. Construct from reinforced concrete in sizes as shown on Drawings.
- B. The exposed surface area of the foundation shall have the forms removed and the concrete rubbed out to a smooth finish.

2.05 FUSES

- A. Furnish and install a fuse holder and fuse in each ungrounded leg of the electrical circuit supplying the outdoor luminaire. For pole-mounted fixture located behind handhole cover Bussman HCB series fuse holders with type FNM fuses or equal. Every luminaire shall be separately fused with a waterproof fuse holder. Size the fuse for the amperage of the luminaire. Tap the circuit conductors with a minimum #10 AWG conductor to serve the luminaire. The fuse and holder shall be accessible through the handhole. Provide sufficient wire to bring fuse holder outside of handhole.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and Project conditions.
- B. Verify foundations are ready to receive fixtures.

3.02 INSTALLATION

- A. Install concrete bases for lighting poles at locations as indicated on Drawings in accordance with Section 03 30 00.
- B. Install poles plumb. Install double nuts to adjust plumb. Grout around each base.
- C. Install lamps in each luminaire.
- D. Bond and ground luminaries, metal accessories and metal poles in accordance with Section 26 05 26. Install supplementary grounding electrode at each pole.
- E. For wall mounted fixtures on exterior walls with metal wall panels, provide junction box mounted to structural wall with required extension ring brought out flush with face of metal panel. Install fixture mounting plate to face of panel with gasketing to seal around extension ring and wall panel. Coordinate installation with wall panel contractor. Ground fixture to equipment ground conductor for circuit.

3.03 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting and balancing.
- B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- C. Measure illumination levels to verify conformance with performance requirements.
- D. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.04 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting and balancing.
- B. Aim and adjust luminaries to provide illumination levels and distribution as indicated on Drawings and Submittals.

3.05 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean photometric control surfaces as recommended by manufacturer.
- C. Clean lens, finishes and touch up damage.

3.06 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting finished work.
- B. Relamp luminaries having failed lamps at Substantial Completion.

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END OF SECTION

SECTION 27 00 00 – COMMUNICATIONS

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes general design requirements, administration topics, and installation for communications systems.

1.02 SYSTEM DESCRIPTION

- A. The objective of this project is to provide a complete communications cabling infrastructure system installation including, but not limited to: fiber backbone, riser system, horizontal data and voice cabling with attendant terminations, mounting equipment, cable pathway and management systems, testing and other items/materials, as specified in drawings, these specifications, and contract documents.
- B. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270526 Grounding and Bonding for Communications Systems
 - 3. Section 270528 Pathways for Communications
 - 4. Section 271100 Communications Equipment Room Fittings
 - 5. Section 271500 Communications Horizontal Cabling
 - 6. Section 274100 Audio-Visual Systems (including related sub-sections)
 - 7. Section 280000 Electronic Security (including related sub-sections)

1.03 SCOPE OF WORK

- A. This section establishes an infrastructure to be used as signal pathways for communications systems, but is not limited to the following:
 - 1. Comply with all Project Contract documents and the following requirements for a complete project installation.
 - 2. Provide a structured cabling system as described hereafter that includes, but is not limited to, supplying, installing and testing of: backbone cabling, riser cabling; data and voice horizontal cabling, cable connectors, communications outlets and terminations, and equipment racks/cabinets for networking hardware and patch panels.
 - 3. Furnish all labor, materials, tools, equipment and services for the installation described herein.
 - 4. Follow industry standard installation procedures for communications cable to assure that the mechanical and electrical transmission characteristics of this cable plant and equipment are maintained.
- B. Work of this section covers complete installation of permanent and channel links for a data and voice communications networks utilizing copper and fiber transmission media that includes, but is not limited to the following:
 - 1. Provide, install, terminate, test, and document all fiber and copper backbone cables, riser cables, and horizontal cables.

2. Provide and install all termination devices such as, but not limited to, modular patch panels, termination blocks, information outlets (jacks and plates), phone jacks, fiber distribution panels, bulkheads, connectors, and fiber fan out kits. Document all termination devices with proper labeling.
3. Provide in quantities specified, interconnect components such as, but not limited to, fiber patch cables, copper patch cords, and station cables.
4. Provide and install specified Telecommunication Room equipment such as, but not limited to, racks, cabinets, horizontal and vertical cable support devices, cable trays and cable runway, and required mounting brackets/hardware.
5. Provide and install UL-approved firestopping systems in all communication pass-through locations of rated ceiling, wall or floor penetrations involving, conduits, cable, and cable trays in coordination with General Contractor.
6. Provide and install grounding and bonding connection to the bus (PBB/SBB) provided by Division 26.
7. Provide and install all appropriate consumable items required to complete the installation.
8. Coordination with other trades.
9. Provide complete documentation and demonstration of work.
10. Provide indexed and organized complete Test Results of all copper and fiber cable and their components in native format.
11. Provide Submittals as outlined below.
12. Provide a Manufacturer's Extended Product Warranty and System Assurance Warranty for this wiring system.
13. Conduct a final document handover meeting with client, consultant, and PM to review, discuss and educate the Owner on the final product, test results, and As-Built Drawings.

C. Changes to the Scope of Work

1. Owner changes to the scope of work shall be in writing.
2. Change orders shall be submitted to the Owner/Project Manager complete with price breakdown and description for approval before any work is done.
3. The Contractor shall respond to these changes with a complete material list, including pricing, labor, and taxes in writing to be presented to the Owner for approval.
4. The Contractor shall not proceed with additional scope of work without signed approval by the Owner. Owner will not pay for additional work performed by the Contractor without written/signed approval of these changes.
5. Contractor will attach a copy of the signed change order with billing information.

1.04 PRODUCTS AND WORK BY OTHERS (NIC)

- A. The Owner may separately procure and/or provide certain equipment and component that will be installed during the course of project. Such items may not be indicated in the documents.
- B. Contractor shall cooperate with the Owner and Owner's suppliers when considering:
 1. The provision and installation of phone systems, related system equipment/software, and employee station equipment/software.
 2. The provision and installation of multi-port routers, switches, and other Layer 2 / Layer 3 networking components in communications rooms.

3. The provision and installation of Uninterruptable Power Source (UPS) devices in communications rooms.
4. Communications grounding busbars and grounding wires connecting to the main building electrode system.
5. Dedicated power panels, ground busbars, circuits, and utility outlets.
6. The installation and finishing of plywood backboards.
7. Building mechanical ductwork, cooling/heating system (HVAC), and environmental control sensors.
8. Communication pathway devices such as, but not limited to, cable tray and flex-tray in corridors, office spaces and open areas, outlet boxes and stub-ups, conduits, conduit sleeves, and penetrations in walls and floors.

1.05 SUBSTITUTION PROCEDURES

- A. Substitution may be considered when a product becomes unavailable through no fault of the Contractor. An alternate product must be equal to or exceed specified requirements. The material substituted shall not void, alter or change manufacturers' structured cabling system warranty.
- B. Document substitution requests with complete data substantiating compliance of proposed substitution with Contract Documents. Include in each request for substitution:
 1. Product identification, manufacturer's name and address.
 2. Product Data:
 - a) Description, performance and test data, reference standards, finishes and colors.
 - b) Samples: Finishes.
 - c) Complete and accurate drawings indicating construction revisions required (if any) to accommodate substitutions.
 - d) Data relating to changes required in construction schedule.
 - e) Cost comparison between specified and proposed substitution.
- C. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- D. The Owner will be the final judge of acceptability, with review by DataCom Design Group and the distribution of the acceptance by the Architect.
- E. No substitute shall be ordered, installed or utilized without the Architect's prior written verification of acceptance from the Owner.

1.06 REFERENCES AND RELATED DOCUMENTS

- A. Drawings and General provisions of the contract, including Uniform General Conditions, Supplementary General Conditions, Architectural plans and specifications, requirements

of Division 1, Electrical, Mechanical, Plumbing, Audio-Visual, Security and Communications specifications and plans, and the publications listed below apply to the Communications section, are incorporated into this specification by reference, and shall be considered a part of this section.

- B. Reference to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean reference to the latest printed edition of each in effect at the date of contract.
- C. The Contractor shall read all sections in their entirety and apply them as appropriate for work in this section.
- D. Conflicts
 - 1. Drawings and specifications are to be used in conjunction with one another and to supplement one another.
 - 2. In general, the specifications determine the nature and quality of the materials and tests, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to during the installation of the communications system components.
 - 3. If there is an apparent conflict between the drawings and specifications, or between specification sections, the items with the greater quantity and/or quality shall be estimated and installed.
 - 4. Clarification with the Owner and/or DataCom Design Group about these items shall be made in writing prior to procurement and installation.
- E. Codes and Standards
 - 1. American National Standards Institute/Telecommunications Industry Association (ANSI/TIA)
 - a) ANSI/TIA-568.0-E "Generic Telecommunications Cabling for Customer Premises"
 - b) ANSI/TIA-568.1-E "Commercial Building Telecommunications Infrastructure Standard"
 - c) ANSI/TIA-568.2-D "Balanced Twisted-Pair Telecommunication Cabling and Components Standard"
 - d) ANSI/TIA-568.3-D "Optical Fiber Cabling Components Standard"
 - e) ANSI/TIA-568.4-D "Broadband Coaxial Cabling and Components Standard"
 - f) ANSI/TIA-569-E "Telecommunications Pathways and Spaces"
 - g) ANSI/TIA-606-C "Administration Standard for Commercial Telecommunications Infrastructure"

- h) ANSI/TIA-607-D "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications"
 - i) ANSI/TIA-758-C "Customer-Owned Outside Plant Telecommunications Infrastructure Standard"
 - j) ANSI/TIA-862-B "Building Automation Systems Cabling Standard"
 - k) ANSI/TIA-942-B: "Telecommunications Infrastructure Standard for Data Centers"
 - l) ANSI/TIA-1152-A: "Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling"
2. BICSI
- a) BICSI Outside Plant Design Reference Manual
 - b) BICSI Telecommunications Distribution Methods Manual (TDMM)
3. Central Health Network Infrastructure Specifications
4. Local, county, state and federal regulations and codes in effect as of date of installation.
5. Equipment of foreign manufacture must meet U.S. codes and standards.
- a) It shall be indicated in the proposal the components that may be of foreign manufacture, if any, and the country of origin.

1.07 QUALITY ASSURANCE

- A. Communications Contractor shall have a complete working knowledge of low voltage communications cabling applications such as, but not limited to data, voice and video network systems.
- B. Communications Contractor shall have installed similar-sized systems in at least ten (10) other projects in the last five (5) years prior to this bid and be regularly engaged in the business of installation of the types of systems specified in this document.
- C. Communications Contractor and individual installation crew members shall be experienced and qualified to perform the work specified herein at time of bid submission. All onsite supervision personnel that will be assigned to this project shall be listed in the Pre-Installation Submittal.
 - 1. 80% shall have a minimum of three (3) years of experience in the installation of the types of systems, equipment, and cables specified in this document prior to this bid.
 - 2. All installation team members must demonstrate knowledge and compliance with all applicable methods, standards, and codes.
 - 3. All members of the installation team shall be certified by the Structured Cabling System Assurance Warranty provider as having completed the necessary training to complete their part of the installation and capable of an installation that falls

under manufacturer's guidelines necessary to obtain the Manufacturer's System Assurance Warranty.

4. Any personnel substitutions shall be noted in writing to the Owner.
- D. A BICSI RCDD shall supervise and approve all on-site work as a recognized member of the Contractor's installation team.
- E. Refer also to General Conditions.

1.08 CONTRACTOR REQUIREMENTS

- A. In order to accomplish the conditions of this agreement, the Contractor shall perform the specific duties listed herein.
- B. Contractor shall provide and pay for all labor, supervision, tools, equipment, test equipment, tests and services to provide and install a complete communications cabling infrastructure system. Pay all required sales, gross receipts, and other taxes.
- C. Insurance
 1. The Contractor shall procure, submit for review, and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or in connection with, the performance of work hereunder by the Contractor, his agents, representatives, employees or subcontractor. The Contractor shall pay the cost of such insurance.
 2. The Owner, its directors, officers, representatives, agents and employees, respectively, shall have no responsibility to the Contractor with respect to any insurance in accordance with the provisions set forth herein.
- D. Regulatory Requirements
 1. Communications Contractor shall supply all city, county, and state telecommunication cabling permits required by Authority Having Jurisdiction (AHJ).
 2. Communications Contractor shall be licensed and/or bonded as required for telecommunications/low voltage cabling systems.
- E. Privacy and Confidentiality
 1. The Contractor will respect and protect the privacy and confidentiality of Owner, its employees, processes, products, and intellectual property to extent necessary, consistent with the legal responsibilities of the Owner policies.
 2. Contractors shall sign a non-disclosure agreement and abide by the requirements to keep confidential all information concerning bid documents and this project.
- F. Use of Subcontractors
 1. Successful bidder shall inform the Owner's contact and General Contractor in writing about the intention to use Subcontractors and the scope of work for which they are being hired.

2. The Owner or Owner's designated contact must approve the use of Subcontractors in writing prior to the Subcontractor's hiring and start of any work.
- G. The Contractor's designated Project Manager will be recognized as the single point of contact. The Project manager shall oversee all work performed to ensure compliance with specifications as outlined in bid documents (which includes all specifications, references, and drawings) to ensure a quality installation and attend project meetings with the telecommunication consultant, the Owner and others.
- H. Coordination
1. Coordinate installation work with other trades (examples include ceiling grid contractors, HVAC and sheet metal contractors, etc.) to resolve procedures and installation placement for cable trays and cable bundle pathways.
 2. The goal of this coordination will be to establish priority pathways for critical data/voice network cable infrastructure, materials, associated hardware, as well as mitigate delays to the project and to allow service access for communications and HVAC components.
 3. Exchange information and agree on details of equipment arrangements and installation interfaces.
 4. Coordinate with electrical contractors and plan for the pathway routes used communications cabling to minimize cable lengths. Report any potential over distance cable runs for approval before pulling the cables.
 5. Record agreements with other trades and distribute record to other participants, Owner and telecommunication consultant.

1.09 PRE-INSTALLATION MEETINGS

- A. Communications Contractor shall attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section. This venue is to ask and clarify questions in writing with consultant and/or project manager/Owner representative.
- B. Agenda
1. Safety
 2. Work to be performed
 3. Scheduling
 4. Coordination
 5. Other topics as necessary
- C. Attendance
1. Communications project manager/supervisor shall attend meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this document.
 2. All individuals who will serve in an on-site supervisory capacity, including project managers, site supervisors, and lead installers, shall be required to attend the pre-installation conference. Individuals who do not attend the conference will not be permitted to supervise the installation and testing of communications cables on the project.

1.10 CONTRACT ADMINISTRATION

- A. DataCom Design Group may perform site visits and provide job field reports upon inspection of Contractor's installation, materials, supporting hardware, coordination with other trades and progress to schedule to the client.
- B. Job Field Report outline:
 - 1. General: The general installation progress in relation to scheduled work made by the Contractor up to that date.
 - 2. Deficiencies and/or Items of Note: Documents observations of the cable installation that may require corrective action by the Contractor.

1.11 POST INSTALLATION MEETINGS

- A. At the time of substantial completion the contractor shall call and arrange for a post installation meeting to present and review all submittal documents to include but not be limited to As-Built Drawings, Test reports, Warranty paperwork, etc.
- B. Attendees shall include
 - 1. Communications Contractor
 - 2. Project Manager/Owner Representative
 - 3. DataCom Design Group
 - 4. General Contractor
 - 5. Other trades that the GC deems appropriate.
- C. At this meeting the Communications Contractor shall present and explain all documentation.
- D. Any discrepancies or deviations noted by and agreed to by participants shall be remedied by the Communications Contractor and resubmitted within one (1) week of the meeting.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Coordination with delivery companies, drivers, site address, and contact person(s) will be the responsibility of the Contractor.
- B. Communications Contractor requirements:
 - 1. Be responsible for prompt material deliveries to meet contracted completion date.
 - 2. Coordinate deliveries and submittals with the General Contractor to ensure a timely installation.
 - 3. No equipment materials shall be delivered to the job site more than three weeks prior to the commencement of its installation.
 - 4. Equipment shall be delivered in original packages with labels intact and identification clearly marked.
 - 5. Equipment shall not be damaged in any way and shall comply with manufacturer's operating specifications.
 - 6. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants.
 - 7. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

8. Contractor shall be responsible for all handling and control of equipment. Contractor is liable for any material loss due to delivery and storage problems.
- C. Owner/General Contractor shall provide the security requirements for Contractor to follow.

1.13 PROJECT/SITE CONDITIONS

- A. For all environmental recommendations, refer to master Architectural section.
- B. For all security recommendations, refer to related consultant sections.
- C. Contractor shall provide daily a clean work environment that is free from trash/rubbish accumulated during and after cabling installation.
- D. Contractor shall keep all liquids (drinks, sodas, etc.) away from finished spaces. If any liquid or other detriment (cuts, soils, stains, etc.) damages any finishes, Contractor shall provide professional services to clean or repair scratched/soiled finishes, at Contractor's expense.
- E. Damage by Communications Contractor to the work of others will be remedied at the Contractor's expense in a timely manner.

1.14 WARRANTY

- A. The Contractor shall be a certified Manufacturer's Value Added Reseller (VAR) and/or Authorized Installer and provide an end-to-end product warranty, adhere to the industry standard engineering, installation and testing procedures and utilize the authorized manufacturer components and distribution channels in provisioning this project.
- B. Contractor shall coordinate with manufacturer for warranty paperwork and procedures prior to the start of the project.
- C. Contractor shall provide a minimum one (1) year warranty on installation and workmanship PLUS an Extended Product Warranty and System Assurance Warranty for this wiring system and shall commit to make available local support for the product and system during the Warranty period.
 1. The Extended Product Warranty shall apply to all passive structured cabling system components and shall cover the replacement or repair of defective products and labor for the replacement or repair of such defective products for a minimum of one (1) year.
 2. The System Assurance Warranty provides a complete system and product warranty that will be extended to the end-user, ensuring the structured cabling system will be free of defects in materials and workmanship, will meet or exceed applicable performance requirements defined in the contract documents, and support all current and future network applications for a minimum of twenty (20) years.
- D. System Certification: Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturer, registering the installation.

1.15 PAYMENT

- A. Refer to the General Contractor contract documents and/or master specifications issued by Architect for project and cost payment details.

1.16 SUBMITTALS

- A. Refer to Requirements of Division 1.
- B. Refer to Sections 271300 and 271500.
- C. The Communications Contractor shall not perform any portion of the work requiring submittal and review of shop drawings, product data, or samples until Owner has approved the respective submittal in writing. Such work shall be in accordance with approved submittals.
- D. Pre-Installation Submittal Requirements
 - 1. Communications Contractor shall provide certificates for the appropriate insurance coverage as defined in contract documents.
 - 2. City, county, and/or state telecommunication cabling permits as required by Authority Having Jurisdiction (AHJ).
 - 3. Executed non-disclosure agreement.
 - 4. Appoint a Project Manager and provide the name and contact information.
 - 5. Shop Drawings
 - a) Communications Contractor shall submit, for approval, floor plans that identify all device locations, cable routes, cable lengths, cable quantities and cable types, riser locations, and references to installation details and diagrams.
 - 1) Communication Contractor shall notify Owner of cable routes exceeding standardized lengths.
 - b) Communications Contractor shall submit, for approval, diagrams that show room layouts, rack layouts (including elevations), riser layouts, etc.
 - c) The Contractor shall make any corrections as required by the consultant team and submit revised shop drawings to the team for approval.
 - d) Approval by the Consultant of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from the drawings or specifications, nor shall it relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules. Requests to deviate shall be submitted in writing to the Architect.
 - 6. Product Data Cut-sheets
 - a) Communications Contractor shall submit catalogue cut-sheets that include manufacturer, trade name, and complete model number for each product

specified. Model number shall be handwritten and/or highlighted to indicate exact selection.

- b) Communications Contractor shall identify applicable specification section reference for each product performance for each component specified for approval prior to purchase and installation.

7. Warranty

- a) The Communications Contractor shall submit appropriate documentation from the certifying manufacturer showing the project is registered and qualified for the System Assurance Warranty.
- b) All subsequent work shall be in accordance with approved submittals. The Communications Contractor shall not perform any portion of the work requiring approval of the System Assurance Warranty manufacturer's warranty registration qualification procedures that would disqualify any part or all of the wiring system from that warranty qualification.

8. Qualifications

- a) Communications Contractor shall submit a list of the Contractor's previous projects that demonstrate qualification for this project. This list shall include, but not be limited to:
 - 1) At least ten (10) other projects in the last five (5) years
 - 2) Name and location of project
 - 3) Project contacts, email addresses, and phone numbers
 - 4) Total square footage
 - 5) Total number of cables/drops
 - 6) Types of media
- b) Communications Contractor shall submit an up-to-date and valid statement of qualifications for those assigned to perform the work specified herein at time of bid submission.
 - 1) Communications Contractor Employees
 - 2) Subcontractors
- c) Manufacturer certifications for Contractor and installers.

9. Cable Testing Plan

- a) The Contractor shall provide a complete and detailed test plan for approval of the cabling system specified herein, including a complete list of test equipment for copper and fiber components and accessories prior to beginning cable testing.
- b) The following minimal items shall be submitted for review:
 - 1) A testing plan that clearly describes procedures and methods.

- 2) Product data for test equipment.
- 3) Certifications and qualifications of all persons conducting the testing.
- 4) Calibration certificates indicating that equipment calibration meets National Institute of Standards and Technology (NIST) standards and has been calibrated at least once in the previous year of the testing date.
- 5) Examples of test reports, including all graphs, tables, and charts necessary for display of testing results.

10. Samples

- a) For workstation outlet connectors, jack assemblies, housings and faceplates for color selection and evaluation of technical specifications and requirements. Confirm with Architect, interior designer, and Owner representative for color before purchasing materials.

E. Closeout Submittal Requirements

1. As-Built Drawings

- a) Communications Design drawings are to be supplied to the Architect to prepare the master "As-Built" drawings.
- b) Submit one electronic copy and one hard copy with project deliverables within three (3) weeks subsequent to substantial completion. Provide a laminated floorplan with drop designations in the respective serving Telecom Room.
- c) As-Built drawings shall be in AutoCAD format, same version as used by Architect and consultant. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing sheets used for the contract documents.
- d) Utilize normal recognized drafting procedures that match AutoCAD standards, Architect and Consultant guidelines, and methodology.
- e) The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, addendum, change notices, site instructions or deviations resulting from site conditions.
 - 1) Contractor shall clearly identify any resubmitted drawing sheets, documents or cut sheets either by using a color to highlight or cloud around resubmitted information.
 - 2) Maintain drawing numbering or page/sheet scheme consistency as per previously issued drawings/documents.
- f) Provide dimensioned plan and elevation views of networking components, showing:
 - 1) All work area outlet locations complete with outlet/cable labeling.
 - 2) Rack and/or cabinet locations complete with labeling.

- 3) One-line diagram of equipment/device interconnections with the cable plant.
 - 4) Standard or typical details of installations unique to Owner's requirements.
 2. The Communications Contractor shall deliver the Installer's Extended Product Warranty and Manufacturer's signed System Assurance Warranty of installed cabling system to include all components that comprise the complete cabling system.
 - a) Delivery shall be completed within two (2) weeks of the time of final punch list review.
 - b) Product Certificates shall be signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.
 3. Cable Testing Report Requirements
 - a) Submit certified test reports of Contractor-performed tests. Contractor shall submit the required Test Reports in the format and media specified, upon completion of testing the installed system.
 - b) The tests shall clearly demonstrate that the media and its components fully comply with the requirements specified herein.
 - c) Three (3) sets of electronic and hardcopy versions of test reports shall be submitted together and clearly identified with cable designations.
 - d) Cable inventory data shall be submitted for all fiber, copper, and coaxial cabling and termination components. Include products furnished:
 - 1) Manufacturer's name
 - 2) Manufacturer's part numbers
 - 3) Cable designations
 - 4) Location and riser assignments
 - 5) Product Data
 4. Supply Owner with training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.
- F. The Contractor's BICSI Registered Communications Distribution Designer (RCDD) supervisor shall review, approve and stamp all documents prior to submitting. The Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein upon completion of all work.

PART 2 PRODUCTS

2.01 SUMMARY

- A. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.
- B. All material and equipment, as provided, should be the standard Commercial-Off-The-Shelf (COTS) products of a manufacturer engaged in the manufacturing of such products.
 - 1. All shall be typical commercial designs that comply with the requirements specified.
 - 2. All material and equipment shall be readily available through manufacturers and/or distributors.
- C. All equipment shall be standard catalogued items of the manufacturer and shall be supplied complete with any optional items required for proper installation.
- D. Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance and backward compatibility.
- E. All materials shall be UL- and/or ETL-approved and labeled in accordance with NEC for all products where labeling service normally applies.
- F. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled. Modification of products that nullifies UL labels is not permitted.
- G. Backward Compatibility: The provided products shall be backward compatible with lower category ratings such that if higher category components are used with lower category components, the basic link and channel measures shall meet or exceed the lower category's specified parameters.
- H. Component Compliance: The provided products shall each meet the minimum transmission specifications listed herein such that no individual component will be less than specifications for permanent link and channel, regardless of the fact that tests for link and channel ultimately meet required specifications.

2.02 ACCEPTABLE MANUFACTURERS

- A. Identification (Labeling) System
 - 1. Brady
 - 2. Dymo
 - 3. Hellerman-Tyton
 - 4. Acceptable alternate
- B. Fire-Stop Systems
 - 1. Hilti
 - 2. SpecSeal
 - 3. 3M
 - 4. Acceptable alternate

- C. Other Products as Referenced in other Division 27 Specifications.

PART 3 EXECUTION

3.01 PREPARATION

- A. Field Measurements

- 1. Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

- B. Established Dimensions

- 1. Where field measurements cannot be made without delaying the work, coordinate with the General Contractor to establish dimensions.
 - 2. When approved in writing, proceed with fabricating units without field measurements.
 - 3. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

- C. Pre-installation inspection

- 1. The Contractor shall visually inspect all cables, cable reels, and shipping cartons to detect possible cable damage incurred during shipping and transport.
 - 2. Visibly damaged goods are not acceptable and shall be replaced by the contractor at no additional cost to the Owner.

3.02 INSTALLATION

- A. General

- 1. Contractor shall install work in accordance with specifications, drawings, manufacturer's instructions and approved submittal data.

- B. Allowable cable bend radius and pull tension:

- a) In general, communications cable cannot tolerate sharp bends or excessive pull tension during installation.
 - b) Refer to cable manufacturer's bend radius recommendations for the maximum allowable limits.
 - c) After installation, exposed cable and other surfaces must be cleaned free of lubricant residue. Use only lubricants specifically designed for cable installation.

- C. Pull Strings

- 1. Provide pull strings in all new conduits, including all conduits with cable installed (trailer strings) as part of this contract.

2. Data and video cables can be pulled in tandem with pull strings.
3. The pull strings must move freely to prevent cable jacket/cable damage during pulls.

D. Labeling

1. Cable labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
2. Flat-surface labels: Self-adhesive vinyl or vinyl-cloth labels, machine printed with alphanumeric cable designations.
3. Provide transparent plastic label holders, and 4-pair marked colored labels.
4. In accordance with ANSI/TIA-606-C "Administration Standard for Commercial Telecommunications Infrastructure":
 - a) Install colored labels according to the type of field as per color code designations.
 - b) Use "designation strip color-code guidelines for voice, data, cross-connect, riser, and backbone fields".
5. Pathway Labels and Labeling System
 - a) Labeling system shall consist of a hand-held portable printer
 - b) Conduits: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive. Label size shall be appropriate for the conduit size. Font size shall be legible from the finished floor.
 - c) Inner duct: Polyethylene general-purpose tagging material attached using tie wraps.
 - d) Junction boxes: General-purpose label designed for powdered coated surfaces with an ultra-aggressive adhesive, trade name. Font size shall be easily visible from the finished floor.
 - e) All labels shall be permanent, i.e. will not fade, peel, or deteriorate due to environment or time.
 - f) Identification
 - 1) All conduits, junction boxes, gutters, and pull boxes shall have machine-generated labels easily visible from the finished floor.
 - 2) Conduits shall be labeled with the word "communications" and the conduit's origination room number and destination room number.
 - 3) The Contractor shall label conduit at each wall and floor penetration and at each conduit termination, such as outlet boxes, pull boxes, and junction boxes, or as otherwise specified in other sections.
 - 4) Junction boxes, gutters and pull boxes shall be labeled with identification name or number as determined by contractor and submitted for approval.

- 5) The Contractor shall label conduit sleeves at each wall and floor penetration.

E. Firestop

1. Provide approved fire-resistant materials to restore originally-designed fire-ratings to all wall, floor, and ceiling penetrations used in the distribution and installation for communications cabling system.
2. Install and seal penetrations (conduit, sleeves, slots, chases) in fire-rated barriers created for communications infrastructure to prevent the passage of smoke, fire, toxic gas, or water through the penetrations.
3. The firestopping material shall maintain/establish the fire-rated integrity of the wall/barrier that has been penetrated.
4. All through penetrations in a fire rated surface require a sleeve, regardless of penetration diameter or penetrating cable count.
5. Using a "ring and string" method of installing cabling for membrane penetrations in a wall cavity is acceptable, provided the solution was accepted by the Owner in writing. Code-compliant firestopping rules still apply.
6. Coordinate firestopping procedures and materials with General Contractor.
7. Sharing the pathway of other trades/utilities through compliant and non-compliant penetrations does not remove the requirement to maintain code-compliant firestopping.
8. Provide and install removable, intumescent mechanical systems in floor chases for all openings greater than 0'-4".
9. Provide and install removable, intumescent, firestop bricks for all openings greater than 0'-4" where there are penetrations through walls.
10. Bricks shall be listed for insertion in fire-rated openings and require restraining materials or apparatus as needed per manufacturers' specifications.
11. Provide manufacturer recommended material for rated protection for any given barrier.
12. Laminate and permanently affix adjacent to chases the following information:
 - a) Manufacturer of firestop system.
 - b) Date of installation/repair.
 - c) Part and model numbers of system and all components.
 - d) Name and phone numbers of local distributor and manufacturer's corporate headquarters.
13. Solutions and shop drawings/submittals for firestop materials and systems shall be presented to the General Contractor for written approval of materials/systems prior to purchase and installation.
14. Materials shall be installed per manufacturer instructions, be UL-listed for intended use, and meet NEC and locals codes for fire stopping measures.
15. The material chosen shall be distinctively colored to be clearly distinguishable from other materials, adhere to itself, and maintain the characteristics for which it is designed to allow for the removal and/or addition of communication cables without the necessity of drilling holes in the material.
16. Develop training manuals with instructions on methods of adding or removing cabling to/from firestopped sleeves and chases.

- F. Within the normal environment, the installed systems shall not generate nor be susceptible to any harmful electromagnetic emission, radiation, or induction that degrades, or obstructs any equipment.
- G. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in cable pathways and backboard layouts to accommodate 20% future increase in structure cable system capacity.
- H. In the event of a breach of the representations and warranties contained herein, the Contractor, at their own expense, shall take all measures necessary to make the cabling system work and comply with the applicable manufacturer written technical recommendations and standards.
- I. System Tests
 - 1. Upon completion of the installation of the communications infrastructure systems, including all pathways and grounding, the Contractor shall test the system.
 - a) Cables and termination modules shall be affixed, mounted or installed to the designed/specified permanent location prior to testing.
 - b) Any removal and reinstallation of any component in a circuit, including faceplates, shall require retesting of that circuit and any other disturbed or affected circuits.
 - c) Approved instruments, apparatus, services, and qualified personnel shall be utilized.
 - d) The Contractor must verify that the requirements of the specifications are fully met through testing with an approved tester (rated for testing parameters listed elsewhere), and documentation as specified below.
 - e) This includes confirmation of requirements by demonstration, testing and inspection. Demonstration shall be provided at final walk-through in soft copy and printed test data.
 - 2. Non-Compliant Cabling
 - a) Testing that shows some or all pairs of a cable do not comply with specifications, without written approval by the Owner, shall be replaced at Contractor's expense (including respective connectors).
 - b) With the Owner's written approval, the over-length cable(s) shall be excluded from requirements to pass standardized tests and shall be explicitly identified.
 - 1) Testing is still required for non-compliant cabling.
 - 2) The tests shall be for wire-mapping, opens, cable-pair shorts, and shorts-to-ground.

- 3) The test results must be within acceptable tolerances and shall be submitted with the Owner's acceptance document.

3. Failed Tests

- a) If tests fail, Contractor shall correct as required to produce a legitimate passing test.
- b) Manipulation of tester parameters on a failing test in order to achieve a passing test is unacceptable.
- c) If the Contractor is found to have manipulated or falsified any failing test result to show a "PASS" for any reason (without written notice and prior approval of the Owner), the Contractor shall be required to employ a Third-Party Testing Agent selected by the Owner to retest the complete cable plant and shall be required to pay all costs associated with this retesting.

4. Owner reserves the right to be present during any or all testing.

3.03 CLEANING

- A. The Contractor will clean all surfaces prior to final acceptance by Owner.

3.04 COMPLETION INSPECTION AND PUNCH LIST

- A. When the Contractor determines that the Scope of Work has been completed in accordance with the plans and specifications, Contractor shall schedule a Completion Inspection with the Owner.
- B. A Punch List will be generated during the Completion Inspection containing deficiencies in need of corrective action.
- C. Complete all punch list deficiencies within 10 working days. The work is not complete until all punch list deficiencies have been addressed.

3.05 ACCEPTANCE

- A. Once all work has been completed, test documentation has been submitted, and Owner is satisfied that all work is in accordance with contract documents, the Owner shall notify Contractor in writing of formal acceptance of the system.
- B. Contractor must warrant in writing that 100% of the installation meets the requirements specified herein (Standards Compliance & Test Requirements).
- C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and receipt of full documentation soft and hard copies as described herein.

END OF SECTION

SECTION 27 05 26 – GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes grounding and bonding products, design requirements and installation for communications systems.
- B. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications
 - 3. Section 270528 Pathways for Communications Systems
 - 4. Section 271100 Communications Equipment Room Fittings
 - 5. Section 271500 Communications Horizontal Cabling
 - 6. Section 274100 Audio-Visual Systems
 - 7. Section 280000 Electronic Security (including related sub-sections)

1.02 REFERENCES

- A. The publications referenced in Section 270000 form a part of this specification. The publications are referred to in the text by basic designation only.
- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. Conflicts
 - 1. Refer to Section 270000.
- D. Codes and Standards
 - 1. Refer to Section 270000.

1.03 SYSTEM REQUIREMENTS

- A. General
 - 1. All conductor wire, busbars and conduit shall be UL listed.
 - 2. The communications ground system shall be independent from all power grounding except for the connection to the building's electrical service main grounding electrode system.
 - 3. Power grounding and/or bonding shall not be allowed to interfere or provide any back feed or be a conductor to the separate communications ground system source or to any communications bonded materials or equipment.
- B. Primary Bonding Busbar (PBB) and Telecommunications Bonding Conductor (TBC)
 - 1. The main ground source feed for the Primary Bonding Busbar (PBB) in the ER (MDF) shall be an independent feed from the building's electrical service main

- grounding electrode system, known as the Telecommunications Bonding Conductor (TBC).
2. The TBC shall be a stranded copper ground wire from the building ground system to the PBB in the ER (MDF) sized at a minimum #4/0 unless otherwise sized by the Electrical Engineer of Record.
 3. The TBC connections shall be low emission exothermic welds at the connecting ends.

C. Telecommunication Bonding Backbone (TBB) and Secondary Bonding Busbar (SBB)

1. The Telecommunication Bonding Backbone (TBB) originates at the PBB and shall be extended from the PBB within the ER (MDF) throughout the building along the same route as the telecommunications backbone pathways, to the Secondary Bonding Busbar(s) (SBBs) in each TR (IDF).
2. The minimum TBB conductor size between busbars shall be a stranded copper ground wire one (1) AWG size smaller than the Telecommunications Bonding Conductor (TBC).

D. Backbone Bonding Conductor (BBC)

1. Whenever two or more TBBs are used in a multistory building, the TBBs shall be bonded together with a BBC (by low emission exothermic welds) at the top floor and at a minimum of every third floor in between with a copper conductor equal to the gauge of the TBB.

E. TEBC and RBC

1. All cabinets and racks shall be connected by the Telecommunications Equipment Bonding Conductor (TEBC). The TEBC is a stranded copper #4 conductor from the PBB/SBB extending along each row of racks within the room. Bond each rack with a Rack Bonding Conductor (RBC). The RBC is a stranded copper #6 conductor connected to the vertical rack bonding terminal. All connections shall be irreversible crimp connections. Route conductor so as to minimize the quantity of sweeping bends.

1.04 SUBMITTALS

- A. Refer to Section 270000.

1.05 QUALITY ASSURANCE

- A. Refer to Section 270000.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 270000.

- B. The Contractor shall ship on manufacturer's standard reel sizes of one continuous length. Where cut lengths are specified, mark reel quantity accordingly.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:
- B. Cable Manufacturers
 - 1. Houston Wire and Cable Company
 - 2. Okonite Company
 - 3. General Cable
 - 4. Pirelli Cable Corporation
 - 5. Triangle Wire and Cable
 - 6. Owner Approved Alternate
- C. Electrical Service Entrance Bonding Conductor and Connector Manufacturers
 - 1. Copperweld
 - 2. Thomas & Betts
 - 3. Blackburn
 - 4. Owner Approved Alternate
- D. Exothermic Connector Manufacturers
 - 1. Erico Products (Cadweld)
 - 2. Continental Industries (thermOweld)
 - 3. Harger
 - 4. Owner Approved Alternate
- E. Crimp Connector Manufacturers
 - 1. Thomas & Betts
 - 2. FCI Burndy Electrical
 - 3. O-Z/Gedney
 - 4. Owner Approved Alternate
- F. Telecommunication Grounding Busbars
 - 1. Chatsworth
 - 2. Panduit
 - 3. Leviton
 - 4. Owner Approved Alternate
- G. Bonding Straps
 - 1. Chatsworth
 - 2. Harger
 - 3. Brundy
 - 4. Owner Approved Alternate
- H. C-Type Compression Taps

1. Brundy
 2. Harger
 3. Owner Approved Alternate
- I. Antioxidant Joint Compound
1. Chatsworth
 2. Owner Approved Alternate
- J. Labeling
1. Refer to Section 270000.
- K. Firestopping
1. Refer to Section 270000.

2.02 MATERIALS

- A. Communications Grounding Conductors: Copper American Wire Gauge (AWG) wire of the following sizes:
1. Telecommunications Bonding Conductor (TBC): #4/0 (unless otherwise sized by the Electrical Engineer of Record)
 2. Telecommunication Bonding Backbone (TBB): #3/0 (unless otherwise sized by the Electrical Engineer of Record)
 3. Backbone Bonding Conductor (BBC): equal AWG as the TBB (unless otherwise sized by the Electrical Engineer of Record)
 4. Telecommunications Equipment Bonding Conductor (TEBC): #4
 5. Rack Bonding Conductor (RBC): #6
- B. Grounding Connectors
1. Connectors shall be a copper alloy material and two-hole, double-crimp compression lug type at the connecting ends.
- C. Primary Bonding Busbar (PBB)
1. Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
 2. Sized for the immediate requirements and allow for 25% growth.
 3. The minimum dimensions shall be 0'-1/4" thick X 0'-4" wide X 1'-8"/2'-0" long.
 4. Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
 5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression-type copper lugs.
- D. Secondary Bonding Busbar (SBB)
1. Use pre-drilled copper busbar with standard NEMA bolt hole sizing and spacing for the type of connectors.
 2. Sized for the immediate requirements and allow for 25% growth.

3. The minimum dimensions shall be 0'-1/4" thick X 0'-4" wide X 0'-10"/1'-0" long.
 4. Contain (2) tiers of pre-drilled holes for use with standard sizes of two-hole copper compression lugs.
 5. ASTM-B187-C11000 Copper bar suitable for use with two-hole compression type copper lugs.
- E. Equipment Cabinet and Rack Bonding Busbar (RBB)
1. Provide and install a vertical ground busbar in all racks and equipment cabinets to be used as an equipment grounding bus with associated mounting hardware.
 2. The minimum dimensions shall be 0'-3/4" in width by 0'-3/16" in thickness.
 3. The busbar shall have pre-drilled holes and shall be suitable for use with two-hole compression-type copper lugs.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Refer to Section 270000.

3.02 PREPARATION

- A. Refer to Section 270000.
- B. Copper and copper alloy connections should be cleaned prior to connection.

3.03 INSTALLATION

- A. Refer to Section 270000.
- B. The Contractor shall install the work in accordance with the specifications, drawings, manufacturer's instructions and approved submittal data.
- C. All work shall be supervised and reviewed by the Contractor's on-site RCDD.
- D. Installation plans and Requests For Information (RFIs) shall be reviewed by the Contractor's RCDD.
- E. General
1. Bonding and grounding procedures and components shall comply with ANSI/TIA-607-C "Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications".
 2. Bonding should be accomplished such that the bonding system is integrated and compliant with NEC specifications.
 3. Bonding conductors shall be routed with minimum bends or changes in direction and should be made directly to the points being bonded.
 4. Bonding connections should be made by using compression copper lugs. However, for parts of the ground electrode system that are subject to corrosion, must carry high currents reliably, or for locations that require minimum maintenance, connections are made with low emission exothermic welding (see NEC Article 250).

5. Make connections to dry surfaces only.
6. Remove paint, rust, oxides, scales, grease and dirt from surfaces before making connection.
7. Burnish clean a 0'-1" X 0'-1" area, drill, tap, apply an adequate amount of antioxidant joint compound mixed for the metal surface types affected, and bolt conductor and connector to burnished and compounded area. Ensure proper conductivity.
8. Route bonding conductor(s) the shortest distance between bonding contact points.
9. The ground-wire connecting ends shall have a minimum amount of insulation removed at the ground lug.
10. Do not connect ground wire in power cable assemblies to the telecommunications ground system.
11. All grounding and bonding conductors shall be copper and may be insulated. If bare-bonding conductors are used, isolate bonding conductors and prevent contact.
12. Antioxidant material shall be installed to separate dissimilar metals and prevent corrosion.
13. If multiple systems are involved (lightning protection systems, communications, radio and TV, CATV, etc.), those systems shall be bonded together to minimize potential differences between the systems, per NEC 250.94.

F. Telecommunication Bonding Conductors

1. Each telecommunications grounding and bonding conductor shall be labeled at each end detailing the function and room number of its opposite end. Labels shall be located on conductors as close as practicable to their point of termination in a readable position. Labels shall be nonmetallic and include the following text, "TELECOMMUNICATIONS GROUND - DO NOT REMOVE. IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER".
2. Furnish and install all required bonding material, hardware, and utilize tools manufactured for this purpose.
3. The connections of the TBC, TBB, BBC, TEBC, and RBC shall be made using low emission exothermic welding or hydraulically crimped with a double crimp connector. Two-hole grounding lugs are preferred for connection to the grounding bus bars.
 - a) All low emission exothermic welding shall be by Division 26.
 - b) Coordinate with the building services personnel in occupied spaces to prevent the smoke from the exothermic weld process from potentially setting off smoke/fire alarms.
4. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in a ferrous metallic conduit that exceeds 1m (3ft) in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6AWG conductor, minimum.
5. The bonding conductors should be installed without splices.
 - a) Where splices are necessary, the number of splices should be minimized, be accessible, and be located within the telecommunications spaces.

- b) Joined segments of a bonding conductor shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage.

G. Equipment Cabinets and Racks

1. The busbar shall be installed at the base and back of each cabinet/rack for floor fed cabinets/racks.
2. The busbar shall be installed at the top and back of each cabinet/rack for top fed cabinets/racks.
3. Each cabinet and rack shall be provided with a minimum # 6 AWG ground wire.
4. Do not loop from cabinet/rack to cabinet/rack.
5. Each cabinet or rack bay against the wall shall be bottom/side ground fed from the wall.
 - a) Wall ground feeds/raceways to racks shall not be exposed on the walls.
 - b) Exception: Some cabinet or rack bays will require the ground to be fed from the ceiling raceway.
6. All ground raceways within each cabinet/rack or cabinet base and adjacent-ganged cabinet base shall be an insulated metallic flex type raceway and shall not interfere with equipment mounting frames or equipment mounting brackets.

H. Cable Runway, Cable Raceway and Support System Grounding

1. The Contractor shall provide communications cable tray and cable runway systems with a communications dedicated ground from the SBB.
2. All cable tray needs to be electrically continuous per NEC 250.96.
 - a) Metal raceways, wire-mesh cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as an alternate grounding path, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current plausibly to be imposed on them.
 - b) Any nonconductive paint, enamel, or similar coating shall be removed at the threads, contact points, and contact surfaces.
 - c) Grounding or bonding conductors shall be connected by fittings designed for that purpose to ensure adequate bonding.
3. The Contractor shall provide and install a #6 AWG ground wire to bond one end of each cable tray/runway system to the SBB.
4. For electrically non-continuous conduits that contain only grounding conductor, the Contractor shall bond the conduit and conductor together at both ends to ground to the nearest TGB with grounding bushings or ground clamps.

I. Shielded Backbone Cabling

1. The Contractor shall terminate and bond the shield to the nearest SBB or PBB at both ends, following manufacturer's guidelines.

3.04 FIELD QUALITY CONTROL

A. Testing

1. Upon completion of the electrical system, including all grounding, the Electrical Contractor shall test the system for stray currents, ground shorts, etc.
2. Approved instruments, apparatus, services, and qualified personnel shall be utilized.
3. If stray currents, shorts, etc., are detected, eliminate or correct as required.

END OF SECTION

SECTION 27 05 28 – PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes

1. Hangers and Supports, including open-top supports (cable hooks) for communications systems.
2. Conduits and Pull Boxes for communications systems.
3. Cable Tray and Cable Runway with associated accessories and fittings for communications systems.

B. Related Sections

1. Section 260000 Electrical (including related sub-sections)
2. Section 270000 Communications Systems
3. Section 270526 Grounding and Bonding for Communications Systems
4. Section 271100 Communications Equipment Room Fittings
5. Section 271500 Communications Horizontal Cabling
6. Section 274100 Audio-Visual Systems
7. Section 280000 Electronic Security (including related sub-sections)

1.02 REFERENCES

- A.** The publications referenced in Section 270000 form a part of this specification. The publications are referred to in the text by basic designation only.
- B.** Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. Conflicts**
1. Refer to Section 270000.
- D. Codes and Standards**
1. Refer to Section 270000.

1.03 SUBMITTALS

- A.** Refer to Section 270000.

1.04 QUALITY ASSURANCE

- A.** Refer to Section 270000.

1.05 DELIVERY, STORAGE, and HANDLING

- A.** Refer to Section 270000.

B. Conduit Storage

1. Package conduits in bundles maximum 10'-0" long, with conduit and coupling thread protectors for indoor/outdoor storage.
2. Package fittings in manufacturer's standard quantities and packaging suitable for indoor storage.
3. Protect coating on plastic-coated rigid conduit, fittings, and bodies from damage during shipment and storage.
4. Store conduit above ground on horizontal racks to prevent corrosion and entrance of debris.
5. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants. Protect plastic conduit and inner duct from sunlight. Equipment damaged prior to system acceptance shall be replaced at no cost to the Owner.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, manufacturers that may be incorporated in the work, include:

B. Cable Hooks

1. Panduit
2. Erico – CADDY CAT LINKS J-HOOKS
3. Owner approved alternate

C. Cable Tray

1. Cooper B-Line, Inc.
2. Chatsworth (CPI)
3. Hoffman
4. WBT Wire Mesh
5. Owner approved alternate

D. Polyethylene Cable Support System

1. Erico
2. Owner approved alternate

E. Innerduct

1. MaxCell (fabric innerduct)
2. Carlon Riser Guard Flexible Raceway (corrugated innerduct)
3. Owner approved alternate

F. Measured pull tape (pull tape printed with sequential footage markings)

1. Fibertek
2. Condux International
3. Owner approved alternate

- G. Labeling
 - 1. Refer to Section 270000.

- H. Firestopping
 - 1. Refer to Section 270000.

2.02 CABLE HOOKS

- A. Cable hooks shall be factory assembled for direct attachment to walls, hanger rods, beam flanges, purlins, strut, floor posts, etc. to meet job conditions.
- B. Features
 - 1. Cable hooks shall have a flat bottom and provide a minimum of 0'-1.625" cable-bearing surface.
 - 2. Cable hooks shall have 90° radius edges to prevent damage while installing cables.
 - 3. Cable hooks shall be designed so that the mounting hardware is recessed to prevent cable damage.
 - 4. Cable hooks for non-corrosive areas shall be pre-galvanized steel. Where additional strength is required, cable hooks shall be spring steel with a zinc-plated finish.
 - 5. Cable hooks for corrosive areas shall be stainless steel.
 - 6. Cable hooks shall have a stainless steel cable latch retainer to provide containment of cables within the hook.
 - 7. The retainer shall be removable and reusable.
- C. Factory assembled multi-tiered cable hooks shall be used where required to provide separate cabling compartments, or where additional capacity is needed.
- D. Load cable hooks in accordance with manufacturer requirements and recommendations.
- E. Provide capacity for 25% growth, add additional hooks as needed.

2.03 PULL BOXES, JUNCTION BOXES, AND GUTTERS

- A. All junction boxes, gutters and pull boxes shall be UL listed and comply with NEC requirements.
- B. All junction boxes, gutters and pull boxes shall meet the following minimum material requirements:
 - 1. 16-gauge steel or heavier
 - 2. Seams shall be continuously welded and grounded smooth
 - 3. External screws and clamps
 - 4. External mounting feet (where applicable)
 - 5. Oil-resistant gasket and adhesive
 - 6. ANSI 61 gray polyester powder coating inside and out over phosphatized surface

- C. All junction boxes, gutters and pull boxes shall be provided with bushings for conduits and/or cabling.
- D. All junction boxes, gutters and pull boxes shall be securely installed.

2.04 CONDUITS

- A. All conduits shall be UL listed and comply with NEC requirements.
- B. Conduit Fittings
 - 1. All fittings shall be compression or threaded.
 - 2. Fittings shall provide a secure connection for pulling communications cables.
 - 3. Setscrew fittings are not permitted.
 - 4. Conduit "condulets" are not permitted.
- C. Non-metallic conduits are not permitted in above ground installations. Conversion fittings are required for non-metallic (below ground) to metallic (above ground) transitions.
- D. Innerduct:
 - 1. All fiber shall be installed in innerduct unless fiber cabling is armored.
 - 2. Shall be constructed of non-metallic material.
- E. Only manufacturer's fittings, transition adapters, terminators and fixed bends shall be used.
- F. Measured Pull Tape
 - 1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn with footage markers printed on the tape.
 - 2. Minimum average tensile strength shall be 1130 lbs. for 0'-1.5" and smaller conduits and innerduct.
 - 3. Minimum average tensile strength shall be 1800 lbs. for conduits larger than 0'-1.5".
- G. Fill and Bend Radius
 - 1. Conduit fill shall comply with NEC requirements.
 - 2. The minimum bend radius is 6 X the conduit inside diameter (ID) for 0'-2" conduit or less.
 - 3. The minimum bend radius is 10 X the conduit ID for a conduit greater than 0'-2".
 - 4. There shall be no more than two 90° bends (180° total) between conduit pull boxes.
 - 5. Changes in direction shall be accomplished with sweeping bends observing minimum bend radius requirements above.
 - 6. Do not use pull boxes for direction changes unless specifically designated otherwise in the drawings.
 - 7. Unless otherwise noted in the drawings, conduits entering pull boxes shall be aligned with exiting conduits.
- H. Routing

1. Conduits shall be routed in the most direct route possible, with the fewest number of bends possible.
2. There shall be no continuous conduit sections longer than 100'-0" for premises conduits. For runs that total more than 100'-0", insert junction or pull boxes so that no continuous run between pull boxes is greater than 100'-0".

I. Penetrations

1. All conduit penetrations shall comply with all applicable fire codes.
2. All conduit penetrations in fire-rated walls or floors shall be sealed and fire-proofed to meet or exceed the designed rating of the penetration area.

2.05 CABLE TRAY

- A. Cable tray systems are defined to include, but are not limited to, straight sections of cable trays, bends, tees, elbows, reducers, crosses, wyes, vertical bends, up/down tees, cable support fittings, drop-outs, supports and accessories.
- B. Install all tray types utilizing manufacturer recommended installation instructions and applicable standards.
- C. Load cable tray and cable runway in accordance with manufacturer requirements and applicable standards.
- D. Cable Tray Materials
1. Aluminum
 2. Pre-galvanized Steel
 3. Hot-dip Galvanized Steel
 4. Stainless Steel
 5. Yellow Zinc Dichromate
 6. Pre-Galvanized Zinc
 7. Electro-Galvanized Zinc
- E. Cable Tray Systems
1. Wire basket (mesh) of types and sizes indicated on the drawings; with connector assemblies, clamp assemblies, connector plates, splice plates, cable drop outs, bonding accessories, and splice bars. Construct units with rounded edges and smooth surfaces.
 2. Continuous mesh polyethylene cable-support system: with connector assemblies and appropriate support components. All parts shall be UL-listed. Plastic (non-metallic) parts shall have a zero detectable halogen content as substantiated by an independent test laboratory.
 3. Ladder type trays shall consist of two longitudinal members (side rails) with transverse members (rungs) welded to the side rails. Rungs shall be spaced 0'-9" on center. Spacing in radius fittings shall be 0'-9" as measured at the center of the tray's width. Rungs shall have a minimum cable-bearing surface of 0'-.875" with radius edges. No portion of the rungs shall protrude below the bottom plane of the side rails.
 4. Ventilated trough type trays shall consist of two longitudinal members (side rails) with a corrugated bottom welded to the side rails.

5. Solid bottom trough type trays shall consist of two longitudinal members welded to the side rails.
- F. Cable trays shall have sufficient depth and width so as not to exceed a maximum 50% fill ratio, including 25% capacity for anticipated growth.
- G. All straight sections shall be supplied in minimum 8'-0" lengths, except where shorter lengths are permitted to facilitate tray assembly lengths.

2.06 HANGERS AND SUPPORT

- A. Steel support brackets shall be galvanized steel and capable of supporting a minimum of 200 lbs with a safety factor of 3.
- B. Steel support brackets shall have a removable galvanized steel retaining strap.
- C. Steel support brackets shall accept 0'-3/8" (10mm) threaded rod for attachment to building structure or sub structure.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Refer to Section 270000.

3.02 PREPARATION

- A. Refer to Section 270000.
- B. Verify system is properly sized for cables before installation.
- C. Verify that the manufacturer recommended loads are not exceeded.
- D. Verify general routing and coordinate locations with other trades before installation. Layout cable runs in advance to determine quantities of cable to be installed along pathways, and to ensure non-interference from other trade installations.

3.03 INSTALLATION

- A. Refer to Section 270000.
- B. Cable Hooks
 1. Provide cable hook (j-hook) cable support system for horizontal and/or riser cabling in accessible ceiling space. Assemblies shall be complete with mounting hardware.
 2. Provide threaded rod for supporting hangers when hanging from floor deck and deck members.
 3. Follow manufacturers fill capacities.
 4. Locate cable hooks on 4' to 5' centers to adequately support and distribute the cable's weight.
 5. Suspended cables shall be installed with at least 0'-3" of clear vertical space above the ceiling tiles and support channels.

6. For larger quantities of cables, provide special supports that are specifically designed to support the required cable weight and volume.
7. Do not support pathways or cables with the ceiling suspension system or use electrical, plumbing, or other pipes for support.
8. Cable supports shall be permanently anchored to building structure or substrates. Provide attachment hardware and anchors designed for the structure to which attached, and that are suitably sized to carry the weight of the cables to be supported.
9. Secure and support exposed horizontal cable at intervals not exceeding 5'-0" and not less than 1'-4" (16") from cabinets, pack pole, boxes, fittings, outlets, racks, frames, and terminals.
10. Cable sag between vertical supports for horizontal pathway shall not exceed 0'-6". Provide at least 0'-3" cable sag between supports.
11. Painted J-hooks shall meet or exceed NEC requirements for the environment in which the product is installed.

C. Conduit and Pull Boxes

1. The Contractor shall route the conduit in approximate locations unless drawing is dimensioned for precise placement.
2. Conduit cuts shall be square. Ream ends of burrs and remove metal shavings and cutting lubricants before conduit is connected to the conduit system.
3. For conduit embedded in concrete, coat threaded connections in conduits with colloidal rust and corrosion inhibitor and sealant. Conduit must be clean and dry and must pass standard sizing test after concrete is poured.
4. Cap unused conduits with watertight caps
5. Make conduit connections with appropriate fittings and tighten securely.
6. Use appropriate tools to install PVC coated conduit; avoid damage to exterior coating.
7. Install liquid-tight flexible metal conduit where exposed to weather, water, or other liquids.
8. Use IMC, PVC conduit, or rigid galvanized steel conduit in underground installations.

D. Innerducts

1. The Contractor shall provide fabric innerduct in all underground conduits, as indicated on the drawings.
 - a) The Contractor shall use pre-lubricated, woven polyester, low friction, and high abrasion resistant fabric.
2. The Contractor shall be trained for proper installation technique by the innerduct manufacturer. The Contractor shall coordinate with the owner to demonstrate that pull ropes in each inner duct cell move freely from end to end.

E. Cable Tray and Cable Runway

1. Cut wire basket tray members square with approved cable tray cutting tool as to not leave sharp edges at cut point. Remove burrs and smooth the ends before the cut is connected to wire-mesh tray system.
2. Ensure that standard splices are designed to have less than 1 milliohm (0.0001 Ω) of resistance between connections and provide bonding between sections.

Painted wire mesh tray requires the outer mask of the non-conductive surface be removed at each end of the tray prior to installing the splice to provide continuity between painted tray sections.

3. Threaded rod (minimum 0'- $\frac{1}{2}$ " diameter) or equivalent and slotted channel shall be used for hanging cable tray between floor deck and deck members

F. Fiber Support:

1. Support vertical fiber optic cable with basket weave wire/cable grips. Support fiber riser with single weave support grip with a single offset eye.
2. Mount/attach pulling eye to a wall or ceiling deck secured hook to support/provide strain relief to riser cable. Provide a minimum 3'-0" loop of fiber prior to entering fire stopped floor sleeve.
3. Where required coil up slack fiber cable into pull box and secure with single weave support grip.

G. Clearances

1. A minimum of 1'-0" access headroom shall be provided above a cable tray. Ensure that other building components do not restrict access to the cable trays from the sides.
2. Power outlets shall not be installed in or mounted to cable tray or cable runway.
3. Provide 3'-0" of unencumbered space for every 10'-0" segment of tray.
4. Cable tray clearances
 - a) Motors or transformers: 4'-0"
 - b) Power cables and conduit: 1'-0"
 - c) Fluorescent lighting: 0'-5"
 - d) Halide lights: 1'-0"
 - e) Above the ceiling tiles: 0'-3"
 - f) Access above and on one side of the cable tray: 1'-0"

3.04 FIELD QUALITY CONTROL

- A. Test system to ensure electrical continuity of bonding and grounding connections.
- B. Ensure compliance with specified maximum ground resistance.

3.05 CLEANING

- A. Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where Work has been completed unless designated for storage.
- B. Wipe clean all cable trays and apply appropriate manufacturer's paint to areas that have been scratched.

END OF SECTION

SECTION 270543 – UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes underground communications duct banks, hand-holes and maintenance holes
- B. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications Systems
 - 3. Section 270526 Grounding and Bonding for Communications Systems
 - 4. Section 270528 Pathways for Communications
 - 5. Section 271100 Communications Equipment Room Fittings
 - 6. Section 271500 Communications Horizontal Cabling
 - 7. Section 274100 Audio-Visual Systems
 - 8. Section 280000 Electronic Security (including related sub-sections)

1.02 REFERENCES

- A. Refer to section 270000.
- B. Conflicts
 - 1. Refer to section 270000.
- C. Codes and Standards (Most recent editions or as required in contract)
 - 1. Refer to section 270000.
- D. Related Documents
 - 1. Refer to section 270000.

1.03 SUBMITTALS

- A. Refer to section 270000.

1.04 QUALITY ASSURANCE

- A. Refer to section 270000.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped.
 - 1. Store nonmetallic ducts with supports to prevent bending, warping, and deforming

- B. The contractor shall endeavor to make the site ready for installation of manholes when delivered so that they can be placed off of the truck into final position.
 - 1. When this is not possible, store precast concrete and other factory-fabricate underground utility structures as Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.
- D. Clearly mark containers "For Communications Duct Banks Only".
- E. Refer also to section 270000.

1.06 WARRANTY

- A. Refer to section 270000.

1.07 MAINTENANCE

- A. Refer to section 270000.

PART 2 PRODUCTS

2.01 ACCEPTIBLE MANUFACTURERS

- A. Ducts
 - 1. Use owner approved solution
- B. Hand Holes
 - 1. Hubbell
 - 2. Christy Concrete Products
 - 3. Cretex Concrete Products West, Inc.; Riverton Division
 - 4. Oldcastle Precast Group
 - 5. Oldcastle Precast Inc/; Utility Vault Division
 - 6. Utility Concrete Products, LLC
 - 7. Owner Approved equivalent
- C. Maintenance (Man) Holes
 - 1. Christy Concrete Products
 - 2. Cretex Concrete Products West, Inc.; Riverton Division
 - 3. Oldcastle Precast Group
 - 4. Oldcastle Precast Inc/; Utility Vault Division
 - 5. Utility Concrete Products, LLC
 - 6. Owner Approved equivalent
- D. Innderducts
 - 1. MaxCell Fabric Pre-Lubricated Multi-Cell innerduct

2. Owner Approved equivalent

2.02 MATERIALS

A. Continuous Tape for Underground Conduit

1. The Contractor shall use orange warning ribbon, PVC tape (detectable, i.e., containing metallic tracings), three inches wide, permanently imprinted with "CAUTION--BURIED COMMUNICATIONS LINE BELOW" in black letters, minimum 0'-1" high.

B. Labeling

1. Refer to section 270000.

C. Firestopping

1. Refer to section 270000.

PART 3 EXECUTION

3.01 EXAMINATION

- #### A.
- Where necessary, Contractor shall provide all excavation, boring, trenching, backfill and restoration of grounds for all OSP pathways.

1. In addition, Contractor shall include all labor, materials, and equipment.

- #### B.
- The owner of the property has the option to obtain a testing laboratory to ensure proper soil compaction.

- #### C.
- All work shall comply with all city, county and State Codes, NEC, EIA/TIA, OSHA, and BICSI TDMM requirements, codes and standards.

- #### D.
- The above referenced codes and standards are to be considered as a minimum requirement.

1. If the plans or specifications call for material and/or methods of construction higher than the standard, the plans or specification shall govern.

- #### E.
- All holes, trenches and/or any other excavation shall be covered, fenced, and/or taped off to make the area safe at all times.

1. Conform to general Contractor requirements.

- #### F.
- The Contractor will visit the job site prior to submitting a proposal to determine existing conditions.

1. Contractor shall evaluate the site for materials, and any other information that may affect the work to be performed.

- G. The Contractor shall locate and protect all existing conduits.
 - 1. Should damage occur notify the appropriate utility.
 - 2. Damage costs are the responsibility of the Contractor.
- H. The Contractor shall CALL BEFORE YOU DIG, One Call Directory Telephone Numbers (Texas: 1-800-245-4545, 1-800-344-8377) to locate any existing conduits (Power, Gas, Telephone, and other utilities) prior to start of work.
- I. Any proposed re-routing of all trenches/pole lines shall be reviewed and approved by the owner/consultant.

3.02 PREPARATION

- A. Refer to Section 270000.
- B. The Contractor shall verify materials are on-site in proper condition and of sufficient quantity.
- C. The Contractor shall verify proper excavation depth (minimum 4'-0" below finished grade), width, route and support of work.
 - 1. Verify proper location of hand-holes and maintenance holes (minimum every 350'-0").
 - 2. Communications facilities must be placed in separate hand-holes and maintenance holes from electrical facilities.
- D. Trenches greater than or equal to 5'-0" deep shall:
 - 1. Be shored to prevent cave-in.
 - 2. Have 2'-0" clearance from the dirt pile.
- E. Directional boring is a suitable option when trenching is impractical or impossible.
 - 1. Locating existing underground utilities is crucial when directional boring is planned because of the potential for the drilling unit to encounter high voltages.
 - 2. Although directional boring machines are manufactured with electrical strike sensing capabilities, which can warn the operator of any contact with a high voltage source, accidents may still occur.
 - 3. Operators of directional boring machines require special protection due to the potential for exposure to high voltage.
 - a) Therefore, operators must always have a ground mat grid underfoot as insulation protection.
 - b) In addition, operators must wear insulating boots and gloves, along with hard hats and safety glasses.
- F. Minimum separation between electrical and communications underground cable (measured from conduit sidewall):
 - 1. Concrete: 0'-3"

2. Masonry: 0'-4"
3. Well-tamped earth: 1'-0"

G. Before encasement, the Contractor shall:

1. Prove and verify all ducts are free of debris and properly installed in support and spacer system.
2. Verify the system is properly fitted together and hold-down hardware is properly installed.
3. Verify ducts are capped at both ends

3.03 INSTALLATION

A. Refer to section 270000.

B. Hand Holes

1. Unless otherwise shown, Hand-holes shall be at least 4'-0" X 4'-0" and shall be constructed of 0'-2" thick cement covered with 0'-3/8" steel plate.
2. The hand-hole or maintenance hole shall rest on a 0'-4" blanket of sand, and 0'-4" around the sidewalls shall be filled with sand.
3. Each hand-hole or maintenance hole which contains a pedestal shall have four bollards installed 1'-6" (18") diagonally from each corner, with a cross member welded at 2'-6" (30") connecting the four corners.
 - a) These barriers will be constructed of 0'-4" ridged conduit filled with concrete, driven 4'-0" in the ground and extending 3'-0" above the protective cover.
4. All Hand-holes shall have a hasp and locking plate installed so they can be locked with padlock.

C. Maintenance (Man) Holes

1. Precast concrete maintenance hole components shall be in accordance with ASTM C 478.
2. Maintenance hole components shall be designed for H-20 highway wheel loading and specific site conditions.
3. Maintenance hole bases may be either precast or cast-in-place, as appropriate for the application, with a formed recess shaped to match the first precast shaft section.
 - a) The maintenance hole base shall extend 0'-10" below the bottom of the lowest pipe and 0'-6" above the top of the largest pipe.
4. Maintenance hole shafts shall be fabricated only from precast shaft sections, eccentric cone sections and grade rings.
5. Precast maintenance holes shall utilize either an integrally cast embedded pipe connector, or a boot-type connector installed in a circular block out opening in accordance with ASTM C 923.

- a) Connections to existing maintenance holes shall utilize a boot-type connector per ATSM C 923 installed in a cored opening.
 - b) Cast-in-place bases shall incorporate a ring-type seal on the pipe to be imbedded in the concrete.
- D. Concrete and Reinforcing Steel for Encasement
- 1. Furnish products following Division 03, except strengths as follows:
 - a) Compressive Strength: 2500 psi at 28 days, class A
 - b) Flexural Strength: 500 psi at 28 days
 - c) Dye concrete encasement "orange" to identify communications conduit
- E. The Contractor shall install conduit in excavations following drawings.
- 1. If directional boring is utilized, cable or flexible conduits can be attached to the unit and pulled back to the origination point (after the drilling unit reaches its destination).
- F. The Contractor shall install watertight penetrations through foundation, hand-hole and maintenance-hole walls.
- 1. Wherever a hand-hole is used to simply pass through, the conduit entrances and exits will be situated at opposite ends of the hand-hole instead of 90° angles.
- G. The Contractor shall assemble duct banks with non-magnetic saddles, spacers and separators.
- 1. Position separators for 0'-2" minimum concrete separation between outer surfaces of adjacent ducts, and:
 - a) Make uniform required bends with a minimum 2'-0" radius for conduits less than 0'-3" diameter, and a minimum 4'-0" radius for conduits 0'-3" and larger.
 - b) Maintain vertical or horizontal separations of 1'-0" of well-packed topsoil from any electrical service conduit run parallel to communications conduits.
- H. Install concrete encasement fully surrounding reinforcing steel and ducts.
- I. Unless otherwise noted on the drawings, reinforce with longitudinal #5 steel bars placed at each corner and along each face at maximum parallel spacing of 1'-0" on center, and #5 tie-bars transversely placed at 1'-0" on center maximum longitudinal.
- 1. Maintain maximum clearance of 0'-2" from bars to edge of forms and ducts.
- J. For duct banks that are being installed for future use, extend rebar well past end of concrete for future tie-in to future concrete pour to ensure that both sections are firmly tied together to prevent slippage between the two pours.

- K. Add orange colorants at mixing site at the rate of 10 lbs per cubic yard for voice and data cable.
- L. Place concrete with minimum 0'-2" cover surrounding ducts and reinforcement.
- M. Maintain ducts in proper place during concrete placement.
- N. For duct banks that are being installed for future use, all conduits shall be extended minimum of 1'-0" past the end of the concrete and capped.
- O. Transition from nonmetallic to metallic conduit where duct banks enter structures or turn upward for continuation above grade:
 - 1. Where ducts enter structures such as hand-holes, maintenance holes, pull boxes, or buildings, terminate ducts in proper end bells, insulated L-bushings, Meyers hubs or couplings on steel conduits.
 - 2. Ducts shall be sealed to prevent water and debris from entering the building.
- P. Extend below grade conduits to 0'-4" above the finished floor inside a building:
 - 1. Cover or temporarily seal open conduit ends to prevent water and other foreign matter from entering conduit.
- Q. Tag conduits entering pull boxes with stamped stainless steel tags following cable and conduit schedule.
- R. Backfill after concrete cures 24 hours.
- S. The Contractor shall pull a 1'-0" long mandrel (0'-1/4" smaller than duct diameter) through ducts.
 - 1. Pull a rag swab or sponge through to remove debris, until it shows clean.
- T. Where fiber optic cables will be used and/or where indicated in the drawings, innerduct shall be provided.
- U. The Contractor shall provide a metered pull tape in all underground conduits and innerduct:
 - 1. Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn.
 - 2. Minimum average tensile strength shall be 1130 lbs for 0'-1.5" and smaller conduits and innerduct.
 - 3. Minimum average tensile strength shall be 1800 lbs for conduits larger than 0'-1.5".

3.04 CLEANING

- A. Refer to section 270000.

Del Valle Health and Wellness Center
Central Health
Del Valle, Texas
Project No. 2070.00

UNDERGROUND DUCTS AND RACEWAYS
FOR COMMUNICATIONS SYSTEMS
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END OF SECTION

SECTION 27 11 00 – COMMUNICATIONS ROOM FITTINGS

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes basic communications and equipment room design requirements and fittings including:
 - 1. Equipment cabinets, racks, frames and enclosures
 - 2. Cable management and ladder racks
 - 3. Telecommunications service entrance pathways
 - 4. Rack mounted power protection and power strips

- B. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications
 - 3. Section 270526 Grounding and Bonding for Communications Systems
 - 4. Section 270528 Pathways for Communications
 - 5. Section 271500 Communications Horizontal Cabling
 - 6. Section 274100 Audio-Visual Systems
 - 7. Section 280000 Electronic Security (including related sub-sections)

1.02 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.

- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.

- C. Conflicts
 - 1. Refer to section 270000.

- D. Codes and Standards (Most recent editions or as required in contract)
 - 1. Refer to section 270000.

1.03 COMMUNICATIONS ROOMS

- A. Communications rooms must be dedicated to designated equipment and services:
 - 1. Space shall not be used for storage of equipment not related to designated equipment and services.
 - 2. Hazardous or corrosive materials shall not be stored in the space.
 - 3. Piping, ductwork and distribution of power, not related to designated equipment and services shall not pass through or be located within the space.

- a) Foreign piping such as water pipes, steam pipes, soil pipes, sanitary drains, storm drains, A/C ducts, and other unrelated systems utilized for or containing liquids, or gases shall not be installed or pass through communication rooms.
 - b) With the exception of fire sprinklers, all water pipes shall be routed around communications room.
- B. Each communication room shall be equipped with fire detection, fire-extinguishing system and prevention devices. Connect detection devices to base building fire alarm system. A minimum of one (1) smoke detector shall be installed in each communications room.
- C. Walls shall be covered with 0'- $\frac{3}{4}$ " X 4'-0" X 8'-0" AC-grade plywood backboard 1'-0" AFF (smooth side to interior of room mounted vertically), capable of supporting mounted hardware and equipment.
1. Plywood shall be affixed to the studs in the walls with screws that penetrate the studs a minimum of 0'-1", are spaced not greater than 1'-6" (18") apart in each stud, and with screws 0'-0" from the top and bottom of plywood.
 2. Plywood shall be sealed against the wall and painted on all exposed sides with two coats of flat white non-reflective paint.
 3. If applicable fire-treatment verification stamps on plywood shall be left unpainted to be readable.
- D. Communications room walls shall extend from floor slab to ceiling deck, with no drop ceilings installed.
- E. Cable tray or ladder rack should be used to distribute cables between rooms through finished wall penetrations.
- F. Cable ladder rack should be used to distribute cables within rooms, complete with cable bend limiters (drop outs).
- G. To reduce static, floors should not have carpet, but be sealed concrete to prevent concrete dust from forming.
- H. Communications rooms shall have only one lockable entrance door, a minimum of 3'-0" wide and 7'-0" high, that opens towards the outside of the room, and does not open into another room.
1. Doors shall be provided with a lockset for the appropriate technology key with pinned hinges and anti-pry guards.
 2. Doors should have no windows or door seals.
 3. Communications rooms should have no exterior identifying markings.
- I. Mechanical
1. Install monitoring sensors with dedicated environmental controls operating 24 hours a day, 365 days a year in the communications rooms.
 2. Provide ventilation in the communications rooms to dissipate heat generated by active devices.
 3. Temperature and Humidity requirements:

- a) Maintain communication rooms at an average of 68°F to 77°F, with a relative non-condensing humidity of 45% to 55%.
- b) The temperature range should be maintained within $\pm 9^\circ$

J. Plumbing

1. If "wet" fire suppression is used, install wire cages on sprinkler heads to prevent accidental operation.
2. Do not place sprinkler heads over equipment or cabling. In the event of a leak this will protect the equipment and cabling.
3. Drainage troughs are also recommended for leakage protection.

K. Electrical

1. One manufacturer's product is recommended for each type of installation. The mixing of different manufacturer products for one item is not acceptable.
2. No electrical feeders/branch circuits shall be placed in or run through any communications room except as required to service those rooms.
3. The Contractor shall install a slot (a UL-approved fire-rated assembly) to accommodate cable runway entry from corridor and a fire-retardant system (bricks, boards, mechanical, etc). The formed slot shall have no burrs or sharp edges. This opening in the wall will be used to pass data and voice cabling from the corridor cable tray into the communications room.
4. The Contractor shall provide uniform illumination of at least 50 foot-candles (fc) 3'-0" AFF for communications rooms located a minimum of 8'-6" AFF.
 - a) Light fixtures in communications rooms are to be positioned for maximum lighting. Do not install over cable tray, ladder rack, or 1'-7" (19") standing racks.
 - b) Provide enough power receptacles to support equipment and service. Coordinate power requirements of active equipment with electrical designer.

L. Relay Racks

1. 1'-7" (19") X 7'-0" relay racks are to be used for mounting and termination of inter-building and intra-building fiber optic/ copper cables and components.
 - a) The racks shall have adequate horizontal and vertical cable management for the 8P8C patch panels and switches.
 - b) Racks with active electronics shall have rack mounted power strips.

1.04 SUBMITTALS

- A. Refer to section 270000.

1.05 QUALITY ASSURANCE

- A. Refer to section 270000.

- B. Product Standards

1. Equipment and materials shall be standard products of a manufacturer regularly engaged in the manufacture of telecommunications cabling products and shall be the manufacturer's latest standard design in satisfactory use for at least one year prior to bid opening.
2. Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Refer to section 270000.
- B. Coordinate layout and installation of equipment with owner's communications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1.07 PROJECT/SITE CONDITIONS

- A. Refer to section 270000.

1.08 WARRANTY

- A. Refer to section 270000.
- B. At the start of the project, contractor shall register the project with the manufacturer to help insure and facilitate manufacturer's warranty process.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. 1'-7" (19") Floor-Mounted Equipment Racks and Support Components
 1. Chatsworth
 2. Owner approved alternate
- B. Horizontal Runway and Support Components
 1. Chatsworth (CPI)
 2. B-Line
 3. Owner approved alternate
- C. Horizontal Rack-Mount Cable Management
 1. Panduit
 2. Leviton
 3. Owner approved alternate
- D. Vertical Rack-Mount Cable Management
 1. Panduit
 2. Leviton
 3. Owner approved alternate

- E. Equipment Cabinet, Floor-Mounted
 - 1. Panduit
 - 2. Owner approved alternate
- F. Equipment Cabinet, Wall-Mounted
 - 1. Panduit
 - 2. Owner approved alternate
- G. Labeling
 - 1. Refer to section 270000.
- H. Firestopping
 - 1. Refer to section 270000.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Refer to Section 270000.

3.02 PREPARATION

- A. Refer to section 270000.
- B. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
- C. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
- D. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.03 INSTALLATION

- A. Refer to section 270000.

3.04 FIELD QUALITY CONTROL

- A. Refer to section 270000.

3.05 CLEANING

- A. Refer to section 270000.

3.06 ACCEPTANCE

Del Valle Health and Wellness Center
Central Health
Del Valle, Texas
Project No. 2070.00

COMMUNICATIONS ROOM FITTINGS
Section 27 11 00.6 of 6

A. Refer to section 270000.

END OF SECTION

SECTION 27 15 00 – COMMUNICATIONS HORIZONTAL CABLING

PART 1 GENERAL

1.01 SUMMARY

- A. This section of the horizontal cabling portion of a structured cabling system includes:
 - 1. UTP Copper cabling
 - 2. Termination and patch cables
- B. Provide all horizontal cabling, terminating hardware, adapters, and cross-connecting hardware necessary to interconnect all system equipment including equipment located in communications rooms.
- C. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications
 - 3. Section 270526 Grounding and Bonding for Communications Systems
 - 4. Section 270528 Pathways for Communications
 - 5. Section 271100 Communications Equipment Room Fittings
 - 6. Section 274100 Audio-Visual Systems
 - 7. Section 280000 Electronic Security (including related sub-sections)

1.02 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only.
- B. Specific reference in specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. Conflicts
 - 1. Refer to section 270000.
- D. Codes and Standards
 - 1. Refer to section 270000.

1.03 SUBMITTALS

- A. Refer to sections 270000 and 271300.

1.04 QUALITY ASSURANCE

- A. Refer to section 270000.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Refer to sections 270000 and 271300.
- B. Storage temperature range: -40°F to 149°F (-40°C to 65°C)

1.06 PROJECT/SITE CONDITIONS

- A. Refer to section 270000.

1.07 WARRANTY

- A. Refer to section 270000.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Labeling
 - 1. Refer to section 270000.
- B. Firestopping
 - 1. Refer to section 270000.

2.02 ACCEPTABLE COPPER MANUFACTURERS

- A. UTP Plenum Rated Cable (Blue: data/voice / Green: wireless)
 - 1. General Cable
 - 2. Panduit
 - 3. Superior Essex
 - 4. Belden
 - 5. CommScope
 - 6. Owner approved alternate
 - a) Color of Cable Jacket:
 - 1) Blue – Network Access
 - 2) Green – Wireless Access Points
- B. Data/Voice Outlet Components
 - 1. Panduit
 - 2. Owner approved alternate
 - a) Network Access
 - 1) Blue – ER/TR
 - 2) Blue – Field End
 - b) Wireless Access points
 - 1) Green – ER/TR
 - 2) Green – Field End
- C. Patch Panels (48 port - Angled)

1. Panduit – PN# CPP48HDWBLY
 2. Owner approved alternate
- D. Copper Patch Cords
1. Panduit
 2. Owner approved alternate
- E. Wall and/or Rack Mount 110 Termination Blocks
1. Panduit
 2. Leviton
 3. Ortronics
 4. Owner approved alternate
- F. Faceplate for wall-mount telephones
1. Panduit KWP6
 2. Owner approved alternate

2.03 ACCESSORIES

- A. Mount one laminated full-size hard copy in color of an as-built floor plan designating workstation locations, pathways, and communications room locations. Confirm hard copy size with Owner.
- B. Provide clear plastic lamination serving each communication room.
- C. Install the laminated drawings within a protective Plexiglas encasement on the wall of the servicing communications rooms. To ease accessibility the Plexiglas encasement shall be in either flip-down format or file folder format.

2.04 HORIZONTAL COPPER CABLING

- A. Recognized cabling for providing the signal medium from the work area to the communications room shall include the following:
 1. Category 6 UTP cable
- B. Category 6 UTP Cable Requirements
 1. 23/24 AWG solid bare copper
 2. Cable jacket shall comply with NEC Article 800 for use as a plenum cable and shall be UL and c (UL) Listed Type CMP (communications multipurpose plenum)
 3. Cable shall terminate on an eight-pin modular jack at each outlet. All horizontal cabling shall meet or exceed the ANSI/TIA-568.2-D Commercial Building Telecommunications Cabling Standard, Part 2: Balanced Twisted Pair Cabling Components
 4. Cables shall be marked as UL verified with a minimum of Category 6 rating
 5. The cable shall support Voice, Analog Base band Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS-422, RS-485, 10BASE-T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital

Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 Mhz) of analog broadband video

6. The maximum horizontal cable length for Category 6 copper cable from the termination of the cable in the communications room to the outlet is 295'-0".
7. Cable shall meet or exceed the following electrical characteristics:
8. Cable shall be specified to 250 MHz and shall meet the manufacturer's guaranteed electrical performance and physical specifications.

2.05 TERMINATION HARDWARE

A. Patch panels

1. Patch panels shall be rated to match installed cable plant
2. The wiring block shall accommodate #23 AWG cable conductors.
3. All modular cross connect panels shall be UL-listed.

B. Work Area Outlet

1. Universal eight-position jack pin/pair assignments
2. Jack Color:
 - a) Data: Blue
 - b) Voice: Blue
 - c) Wireless: Green

C. Work Area Outlet Faceplates:

1. White or ivory to match electrical outlets.

2.06 PATCH CABLES

A. Verify exact quantities and lengths with Owner prior to purchase

B. Patch Cable requirements:

1. Category 6, stranded UTP cable
2. Standard modular non-keyed, 8-position 8-conductor plug
3. 94V-0 rated
4. UL listed
5. Meets FCC Part 68

C. Provide either a 3'-0", 5'-0", 7'-0", or 10'-0" Patch Cords at the communications room for each installed port.

1. Coordinate with Owner on the active equipment layout prior to purchase to ensure correct sizing of patch cords from patch panels to switching equipment.
2. When connecting voice ports to a copper riser, provide a one-pair stranded 8P8C connector on one end and 110GS on the other end and shall be of appropriate length for application.

D. Provide a 10'-0" Station Cord for each work area outlet port.

- E. Place each size/length patch cord in a separate container, and mark the containers that hold the patch cords with the length of patch cords contained within.
- F. All cords shall conform to the requirements of ANSI/TIA-568.2-D Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL LAN Certification and Follow-up Program.
- G. Cords shall be equipped with an eight-pin modular connector on each end, wired straight through and shall be of appropriate length for application.
- H. All rated patch cords shall be round, and consist of #23 AWG copper, stranded conductors, tightly twisted into individual pairs.
- I. Patch cords shall be made and warranted by the manufacturer of the cabling system installed in this project and shall meet or exceed patch cord specifications as outlined in TIA standards.

2.07 IDENTIFICATION (LABELING) SYSTEM

- A. Refer to sections 270000 and 271300.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Refer to Section 270000 and 271300.

3.02 PREPARATION

- A. Refer to section 270000.
- B. The Contractor shall check pathways, raceways, and other elements for compliance with space allocations, installation tolerances, debris, hazards to cable installation, and other conditions affecting installation prior to installation.

3.03 INSTALLATION REQUIREMENTS

- A. Refer to section 270000.
- B. All installation shall be done in conformance with ANSI/TIA-568-D standards, BICSI methods, industry standards and manufacturer's installation guidelines.
 - 1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities.
 - 2. Failure to follow the appropriate guidelines shall require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation.
 - 3. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

- C. Install cable using techniques, practices, and methods that are consistent with specified data cabling and the installed components and that ensure specified performance levels of completed and linked signal paths, end to end.
 - 1. Pull cables in smooth and regular motions using methods that prevent cable kinking.
 - 2. Pull cables simultaneously if more than one is being installed in the same raceway/pathway.
 - 3. If necessary, use approved cable pulling lubricant
 - 4. Use fish tape, cable, rope, basket weave wire/cable grips, and other tools that will ensure no damage to the media or raceway.
 - 5. Install open cabling parallel and perpendicular to surfaces or structural members following surface contours where possible.
 - 6. Do not bend cable greater than a bend radius of 0'-1".

- D. Provide a 10'-0" service loop at the communications room and shall provide a 3'-0" service loop above the access ceiling or cable trays unless specified otherwise.
 - 1. All service loops shall be a minimum of 1'-6" (18") in diameter and be accessible for maintenance.

- E. Coordinate loop placement and orientation with the technology consultant.
 - 1. This allows for future changes or expansion without installing new cables.

- F. Install cables in continuous "home run" lengths from work station outlet to specified patch panel.
 - 1. No intermediate punch down blocks or splices may be installed or utilized between the communications rooms and the workstation outlet without written Owner permission.

- G. All cable must be handled with care during installation so as not to change performance specifications.
 - 1. Factory twists of each individual pair must be maintained up to the connection points at both ends of the cable.
 - 2. There shall never be more than 0'-1/2" of unsheathed cable at either the wiring closet or the workstation termination locations.

- H. All cabling and associated hardware shall be placed so as to make efficient use of available space.
 - 1. All cabling and associated hardware shall be placed so as not to impair equipment's efficient use of their full capacity.

3.04 CABLING METHODS

- A. The Contractor shall provide cabling in accessible spaces, cable tray, (surface and/or enclosed raceway), conduits, and/or J-Hook cable support system.

1. Within consoles, racks, cabinets, desks, and counters, in accessible ceilings spaces and in gypsum board partitions where open cable method may be used.
 2. Use UL or ETL listed plenum rated cable in all spaces.
 3. Provide all necessary installation materials, hardware, tools and equipment to perform insulation displacement type terminations at all data outlets, patch panels, and voice termination materials.
- B. Conceal raceway and cabling except in unfinished spaces as is practical.
- C. Exposed Cable
1. All station cabling shall be installed inside walls or ceiling spaces whenever possible.
 2. Exposed station cable will only be run where indicated on the drawings and will only be allowed when no other options exist.
 - a) Owner must approve all exceptions.
- D. The Contractor shall utilize conduits/cable tray as indicated on the drawings.
- E. All cabling placed above drop ceilings must be supported by cable tray, J-hooks, caddy bags or conduit.
1. The Contractor shall permanently affix cable supports to the building structure or substrates and provide attachment hardware and anchors designed for the structure to which attached and are suitably sized to sustain the weight of the cables to be supported.
 - a) Attaching cable to pipes or other mechanical items is not permitted.
 - b) Cabling shall not be attached to ceiling grid wires.
 2. Multiple cables are to be dressed every 5'-0" to 7'-0".
 - a) Maximum cable sag between cable hooks is 3"-6".
- F. The Contractor shall route data and voice cables separately in a neat and orderly fashion.
1. No cable ties or wraps shall be used to secure the cables in the runway outside of the communications rooms. Cable ties shall be rated for the environment.
- G. Keep all items protected before and after installation with dust and moisture proof barrier materials/envelopes.
- H. If wiring is terminated on patch panels, data, voice jacks prior to painting, carpet installation, and general finish clean up, these jacks shall be placed in a protective envelope to ensure dust, debris, moisture, and other foreign material do not settle onto jacks' contacts.
1. Envelope will be removed on final trim out after other trades have completed their finish work.
 2. It shall be the Contractor's responsibility to ensure the integrity of these protective measures throughout the life/installation of the project.
 - a) Cable bundles brought into the communications rooms shall be routed and dressed in such a manner that prior to termination the cables are not subject to damage and misuse such as installers walking on the bundles that are on the floor.

- b) Cable pulling force shall not exceed 25 lbs of pulling tension or cable manufacturer's recommended pulling tensions.
 - c) Do not leave cables on the floor unprotected or cable bundles hanging from the ceilings. Coil them up in a temporary manner and protect them from damage.
- I. Communications room cables shall be combed and dressed in a manner as to prevent twists, "braiding" and crossed cables in the cable bundle from the communication room entrance to the termination point at the rear of the patch panel.
- 1. Behind the patch panel, the cable bundle shall be attached to the rear cable support bar, and shall drop out each cable in a neat, cascading manner to prevent crossed and/or interwoven cables to each patch panel port termination point.
 - a) Use Velcro wraps instead of cables ties for all bundling in the communications rooms.
 - b) Plastic/nylon tie-wraps are not allowed to permanently secure cables inside the communications room.

3.05 CABLING SEPARATION

- A. Comply with TIA rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.
- B. Maintain a minimum spacing of 1'-6" (18") from electrical feeders and/or branch circuit wiring including, but not limited to, light fixtures, sources of heat and EMI sources.
- C. Maintain a minimum spacing of 1'-0" from auxiliary systems cabling.
- D. Maintain a 1'-0" separation where cables must pass perpendicularly to electrical, plumbing, or other wiring, conduit, or piping systems.
 - 1. Use non-conduit bushings, if necessary to maintain separation, which allow for the addition of a reasonable number of cables in the future.
- E. Maintain communications pathways away from electrical apparatus such as motor driven equipment and transformers, minimum separation distance of 10'-0" is recommended.

3.06 CABLING TERMINATION

- A. Terminate cables in consistent consecutive order.
- B. Terminate cables onto 8P8C modular patch panels without damaging twisted pairs or jacket.
- C. Arrange cables on patch panels and voice termination hardware in ascending order of room numbers and outlet numbers within rooms.
- D. Provide a 10'-0" service loop for horizontal cables at each rack in communications rooms.
 - 1. Locate loop at ceiling deck or on bottom of cable runway in minimum 1'-6" (18") diameter.

- E. Provide a 3'-6" service loop for horizontal cables at work area outlets. Locate service loop above or below data/voice outlet where vertical cable run transitions to horizontal run.
- F. Maintain twists in cable pairs to within 0'-1/2" of termination.
- G. Video Surveillance Systems Cabling (Electronic Safety and Security <ESS> devices)
 - 1. Video Cameras may require a field terminated plug on the end of a horizontal cable to be directly plugged into device.
 - a) Follow TIA-862-B Building Automation Standard.
 - b) Contractor shall use applicable equipment in testing solid conductor plug.
 - 2. Group all security systems cables in one group.
 - 3. Clearly label cable number and function, in the last positions on the horizontal cabling blocks in each communications room.
- H. Building Systems Cabling (BAS, FA, elevator line, etc)
 - 1. Coordinate exact placement and connectivity requirements with applicable trade prior to installation.
 - 2. Group all building systems cables in one group.
 - 3. Clearly label cable number and function, in the last positions on the horizontal cabling blocks in each communications room.
- I. Limit cable-bending radius to 20X the cable diameter during installation, and 15X the cable diameter after installation.
- J. Start numbering at the left of the main door to the room and continue in a clockwise direction around the room.
 - 1. The cables within the room will be terminated starting with the cables located to the left of the main door to the room and continue around the room in a clockwise direction.

3.07 TERMINATION HARDWARE

- A. Station Hardware
 - 1. Flush mount jacks shall be mounted in a faceplate with back box.
 - 2. Outlets shall not be mounted on temporary, movable, or removable surfaces, doors, or access hatches without prior Owner approval.
 - 3. 8P8C Jack Pin Assignments for work area outlets shall match the T-568B wiring scheme.
- B. Patch panels
 - 1. Copper cables shall be terminated in eight position/eight conductor (8P8C) modular patch panels.
 - 2. All Modular jack panels shall match the T-568B wiring scheme.
- C. Work Area Outlet

1. 8P8C non-keyed modular outlets for applications up to one Gbps and ANSI/TIA-568-D compliant for the specified transmission requirements.

D. Work Area Outlet Faceplates:

1. Furnish and install blank plates in all unused ports.

3.08 SPECIAL CIRCUITS

- A. The Contractor shall coordinate with the Owner on the cable termination plan for special circuits, including cables to wireless access point locations, security, elevators, fire alarms, etc.

B. Wireless Access Points

1. Install one (1) Cat 6 cable from dedicated wireless patch panel(s) in communications room to outlets having 8P8C connectors within a secure metal enclosure.
2. Enclosures shall be NEMA rated for the environment to which they are exposed.

3.09 IDENTIFICATION AND LABELING

- A. Labeling system shall consist of a hand-held portable printer and labels appropriate to the application. Handwritten labels are not acceptable.

- B. Fiber termination hardware (designation strip) shall have a 0'- $\frac{3}{4}$ " x 0'- $\frac{1}{4}$ " thermal transfer printable label with a permanent acrylic adhesive.

- C. 110-type copper termination hardware shall have a laser printable, non-adhesive label designed for 110 terminal block marking.

- D. All labels shall be permanent and shall not fade, peel, or deteriorate due to environment or time.

- E. The Contractor shall provide a copy of the finalized plan in writing to the Owner representative and DataCom Design Group for review and authorization to proceed.

1. Coordinate with Owner for specifications on labeling of all hardware, cabling, and related equipment prior to any testing.

F. Labeling requirements:

1. Label cable terminations on designation strips.
2. Label all cable at each terminating point.
3. Label each port of the work area outlet.
4. Cable identification numbers shall not be duplicated.
5. Label patch panels and wall mounted termination blocks in the communications rooms to match those on the corresponding voice and data outlets.
 - a) The font shall be at least 0'- $\frac{1}{8}$ " in height.
6. Where a wireless access point is installed above an acoustical ceiling, label the ceiling grid frame below the access point, displaying the data port number and, if

applicable, the access point identification number. Coordinate labeling of grid with Owner and Architect prior to application of labels.

7. Label each distribution rack, block and other terminating equipment unit and field within that unit within 0'-4" from the block or patch panel termination. Keep labels in a neat and orderly lineup.
8. Label each connector and each discrete unit of cable-terminating and connecting hardware within connector fields, in wiring closets and equipment rooms.
 - a) Where similar jacks and plugs are used for both communication and data-processing equipment, use a different color for jacks and plugs of each service.
9. Post the cable schedule in a prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations.

G. Location and termination field description

1. Room location
2. Rack-mount or Wall mount
3. Termination field type
 - a) Specific patch panel ports versus a separate dedicated patch panel
 - b) 110-type or M66 blocks

H. Unique identifiers

1. Segregation and position on equipment rack
2. Port color-coding
3. Unique labeling

I. Documentation

1. Provide electronic copy of final comprehensive schedules for project in software and format selected by Owner.
 - a) All labels shall correspond to as-built drawings and to final test reports.
2. All cable inventory data documentation shall be submitted in format coordinated with and approved by Owner so that data can be incorporated into existing databases.
3. Documentation shall include cable identification number, source and destination, type of cable, length of cable and number of pairs or fibers.
4. Complete cross connect documentation is required.

3.10 FIELD QUALITY CONTROL

- A. Refer to section 270000.

3.11 POST-INSTALLATION TESTING

- A. Contractor shall test each pair or strand of every cable prior to acceptance. (100% PASS)

- B. Contractor shall submit acceptance documentation as defined below. No cabling installation is considered complete until test results have been completed, submitted and approved.
- C. Standards Compliance and Test Requirements:
1. Cabling shall meet ANSI/TIA-568.2-D Category 6 Horizontal cabling requirements.
- D. Attenuation, NEXT, PSNEXT, Return Loss, ELFEXT, and PSELFEXT data that indicate the worst case result, the frequency at which it occurs, the limit at that point, and the margin.
1. These tests shall be performed in a swept frequency manner from 1 MHz to highest relevant frequency, using a swept frequency interval that is consistent with TIA and ISO requirements.
 2. Information shall be provided for all pairs or pair combinations and in both directions when required by the appropriate standards.
 3. Length, propagation delay, and delay skew relative to the relevant limit.
 - a) Length, propagation delay, and delay skew shall be tested relative to the relevant limit.
 - b) Test shall also include mutual capacitance and characteristic impedance.
 - 1) Any individual test that fails the relevant performance specification shall be marked as a 'FAIL'.
- E. Cable Test Documentation:
1. Cable test documentation shall be submitted in hard copy and electronic formats.
 - a) If proprietary software is used, disk or CD shall contain any necessary software application required to view test results.
 - b) Electronic reports shall be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report.
 - c) Certificate shall reference traceable circuit numbers that match the electronic record.
 2. Each test record shall contain the cable ID as follows:
 - a) "MEDIA TYPE – SOURCE ROOM – DESTINATION ROOM – STRAND/PAIR #", e.g. MM-MC-HC23-001.
 3. Test results saved within the field-test instrument shall be transferred into an accessible database utility that allows for the maintenance, inspection and archiving of the test records.
 - a) These test records shall be uploaded to the PC unaltered, i.e., "as saved in the field-test instrument".
 - b) The file format, CSV (comma separated value), does not provide adequate protection of these records and shall not be used.
 4. Test reports shall include the following information for each cabling element:
 - a) Wire map results that indicate that 100% of the cabling has been tested for shorts, opens, miss-wires, splits, polarity reversals, transpositions, presence of AC voltage and end-to-end connectivity.
 - b) Length, propagation delay, and delay skew relative to the relevant limit. Any individual test that fails the relevant performance specification shall be marked as a FAIL.

- c) Cable manufacturer, cable model number/type, and NVP
- d) Tester make & model, serial number, hardware version, and software version.
- e) Cable ID and project name
- f) Auto-test specification used
- g) Overall pass/fail indication
- h) Date of test

F. Cable Test Equipment

1. Contractor shall supply all of the required test equipment used to conduct acceptance tests.
2. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years experience in producing field test equipment. Manufacturers shall be ISO 9001 certified.
3. Testing equipment shall be UL-verified to meet Level III accuracy.
 - a) The cable installers shall have a copy of this reference in their possession and be familiar with the contents.
4. Testing equipment shall be within the calibration period recommended by the manufacturer.
5. Testing equipment shall have the latest software and firmware installed.
6. Testing equipment of a given type shall be from the same manufacturer, and have compatible electronic results output.
7. Test adapter cables shall be approved by the manufacturer of the test equipment.
 - a) Adapter cables from other sources are not acceptable.
 - b) Adapter cables must be replaced after 1000 tests to ensure accuracy.
8. Test equipment must have a dynamic range of at least 100 dB to minimize measurement uncertainty.
9. Test equipment must be capable of storing full frequency sweep data for all tests and printing color graphical reports for all swept measurements.
10. Test equipment must include S-Band time domain diagnostics for NEXT and return loss (TDNXT and TDRL) for accurate and efficient troubleshooting.
11. Test equipment must be capable of running individual NEXT, return loss, etc measurements in addition to auto tests. Individual tests increase productivity when diagnosing faults.
12. Test equipment must include a library of cable types, sorted by major manufacturer.
13. Test equipment must be able to internally group auto tests and cables in project folders for good records management.
 - a) Test equipment must store at least 1000 auto tests in internal memory.
14. Test equipment must include DSP technology for support of advanced measurements.
15. Test equipment must make swept frequency measurements in compliance with TIA standards.
16. The measurement reference plane of the test equipment shall start immediately at the output of the test equipment interface connector.
17. There shall not be a time domain dead zone of any distance that excludes any part of the link from the measurement.
18. Acceptable testers:
 - a) Fluke DTX CableAnalyzer

b) Owner approved equivalent

3.12 FIBER TESTING

A. Refer to Section 271300.

3.13 CLEANING

A. Refer to section 270000.

3.14 ACCEPTANCE

A. Once all work has been completed, test documentation has been submitted and approved, and the Owner is satisfied that all work has been completed in accordance with contract documents, the Owner will notify Contractor in writing of formal acceptance of the system.

B. Contractor's RCDD shall warrant in writing that 100% of the installation meets the requirements specified herein.

C. Acceptance shall be subject to completion of all work, successful post-installation testing which yields 100% PASS rating, and submittal and approval of full documentation as described above. Tests with the "*" PASS" (asterisk) will not be acceptable.

1. These circuits must be repaired to meet "PASS".

END OF SECTION

SECTION 27 41 16 - AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. This document covers the general requirements for the installation of audio-video (AV) systems at the Central Health Del Valle Health and Wellness Center in Austin, Texas. This new construction project is a one story clinical facility with waiting rooms, conference rooms, collaboration spaces, and break rooms.

1.02 CODES

- A. Execute work in accordance with best AV system installation practices, National Electrical Code, and applicable state and local codes.

1.03 REGULATIONS

- A. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for hearing impaired and wheelchair access in control areas.

1.04 SUBMITTALS

- A. See Section 01 3000 – Administrative Requirements, for submittal procedures.
- B. Product Data Binders
 - 1. Minimum number of Sets: four (4) or one (1) electronic copy on CD.
 - 2. Timetable
 - a. Submit within thirty (30) days after award of contract.
 - b. Submit simultaneously with Shop Drawings.
 - c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contractor shall reimburse Owner for expenses incurred during additional review process.
 - d. Review and approval of Product Data is required before equipment purchase and installation.
 - e. Bind product data sheets together either in GBC or 3-ring type binders.
- C. Shop Drawings
 - 1. Minimum Number of Sets: four (4) or one (1) electronic copy on CD.
 - 2. Timetable
 - a. Submit within thirty (30) days after award of contract.
 - b. Submit simultaneously with Product Data Binders.
 - c. Allow minimum of ten (10) business days for review. All sets minus one (1) will be returned with review comments. If a resubmit is required, resubmit total quantity of complete sets. If second resubmit is required, Contract shall reimburse Owner for expenses incurred during additional review process.
 - 3. Description:
 - a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
 - b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.
 - c. Each drawing shall include: Project, Building, Location, Contractor Name, Architect, AV Consultant, Date and Revision Number.
 - d. Number and title each drawing in logical manner as a set.
 - e. Include cover sheet with listing of all drawings included in bound set.
 - f. Ensure that labeling on Shop Drawings match labeling on equipment.

- g. Minimum Scale:
 - 1) Floor Plans: 1/8 inch = 1 foot.
 - 2) Rack Elevations: 1-1/2 inch = 1 foot.
 - 3) Plate/Panel Details: 6 inches = 1 foot.
 - 4) Loudspeaker Details: 1 inch = 1 foot.
 - h. Include as a minimum:
 - 1) Floor plans indicating locations of all AV devices, vertical risers, pull boxes, and exposed wiring. Include Device ID (PRJ, SCREEN, FRK, FB, AVP, etc., as referenced in design contract documents), as appropriate for projectors, screens, racks, floor boxes, AV plates in walls, etc.
 - 2) Schematic diagram showing all primary and secondary devices, interconnectivity and signal flow.
 - 3) Plate details showing size, material, finish, connectors, engraving, etc.
 - 4) Mounting detail drawings of loudspeakers, racks, and overhead equipment. Hire services of professional structural engineer, licensed by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended. Include Structural Engineer's stamped report with shop drawing submittal. Report shall include:
 - a) Itemization of items reviewed by the Structural Engineer.
 - b) Confirmation that proposed methods of suspending equipment as shown on the shop drawings conform to required safety factors.
 - c) Confirmation that building structure from which equipment is to be suspended will support equipment including required safety factors.
 - 5) Rack elevations.
 - 6) Complete schematic diagram. One-line diagram with detailed descriptions of product inputs and outputs is acceptable. Include terminal strip details and cable label information. If wiring diagram spans more than three (3) sheets, additionally provide simplified block diagram of entire system on one (1) sheet.
 - 7) Electrical power wiring diagram. Include circuit, switching, and control details.
 - 8) Wiring diagram of grounding and shielding scheme.
 - 9) Drawings for custom-fabricated items (i.e., plates, panels, cables, and assemblies).
 - 10) General construction drawings necessary for completion of work.
- D. Operation and Maintenance Manuals
- 1. Minimum number of Sets: four (4).
 - 2. Bind Operation and Maintenance Manuals using either GBC or 3-ring binders.
 - 3. Format and Minimum Information below:
 - a. Section 1 - System Operation.
 - 1) Introduction/overview to system components and their functions and locations. Include a brief listing of basic system functions.
 - 2) Complete but simple system operating instructions to accomplish basic system functions, written for non-technical personnel.
 - 3) Certificate indicating names of Owner personnel trained by AV Contactor, date of training, name of AV Contractor representative that provided training, and name of project.
 - b. Section 2 - System Documentation.
 - 1) Simplified system one-line schematic diagram showing changes made during construction.
 - 2) Complete inventory of system components including serial numbers. Identify location (equipment rack, over stage, stored in control room, etc.) of each component.
 - 3) Cable and terminal strip documentation including cable numbers, functions, originating locations, terminating locations, and signal levels.
 - 4) All Shop Drawings corrected to reflect as-built conditions.
 - 5) Other data and drawings required during construction.
 - 6) Initial Tests and Adjustments data.

- 7) Final Tests and Adjustments data.
 - 8) CD-ROM discs including all utilized manufacturer's software and saved copies of software configurations (configurations as established during Final Tests and Adjustments).
 - c. Section 3 - Manufacturer's Documentation.
 - 1) For each equipment model at no additional costs to Owner, even if manufacturer does not include costs of such documentation with purchase of equipment item.
 - 2) Manufacturer's Product Data.
 - 3) Operating instructions.
 - 4) Installation instructions.
 - 5) Service information.
 - 6) Schematic diagrams.
 - 7) Replacement parts list.
 - d. Section 4 - Maintenance Information.
 - 1) Preventive maintenance schedule letter clearly stating target dates of six month and end-of-warranty preventative maintenance inspections, and list of maintenance tasks performed.
 - 2) Maintenance instructions including manufacturer's recommended maintenance, recommended maintenance schedule and information concerning proper inspection, testing, and replacement of components.
 - 3) Troubleshooting information complete with instructions for procedures during equipment failure.
 - e. Section 5 - Warranty Information
 - 1) System warranty letter.
 4. Provide three (3) sets on CD-R disc that include all material in Operation and Maintenance Manuals in PDF format except for copyrighted material.
 5. Submit one (1) set of Operation and Maintenance Manuals at least ten (10) days before Final Tests and Adjustments procedures (minus data from Final Tests and Adjustments). This set will be reviewed by Owner and returned to Contractor. Re-submit after Final Tests and Adjustments and include data. NOTE: Do not schedule Final Tests and Adjustments or perform training of Owner personnel before submitting Operation and Maintenance Manual.
 6. Submit remaining number of complete manuals as required by General Conditions within ten (10) days after return of reviewed set(s). Include Final Tests and Adjustment data, warranty period letter, and any other data not included in first submission.
- E. Samples.
1. Request for Samples - Upon request, furnish samples (at no additional cost) to Owner and/or General Contractor of submitted items proposed as substitutes for specified items. Products will be reviewed to determine if proposed substitute items meet required function and quality.
 2. Product Tests
 - a. Products submitted as samples may require testing by independent laboratory. Testing at expense of Contractor.
 - b. Obtain written approval of tested products before incorporating into system.
- 1.05 QUALITY ASSURANCE
- A. AV Contractor Qualifications.
1. Be established AV System Contractor, regularly engaged in furnishing and installing AV systems. NOTE: Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of approved AV Contractor as subcontractor to perform work described herein.

2. Be experienced in installations of similar size and scope within last five (5) years. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years. For verification, submit complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion. At Owner's request, accompany Owner or Owner's representative on visit to any or all example completed projects submitted.
3. Be Authorized Dealer for all major lines of equipment listed in Part 2 (Biamp, Chief, Crestron, JBL, Middle Atlantic, Shure, etc.) Must have at least one permanent staff member who is factory trained in the installation and maintenance of each major product line offered.
4. Employ personnel (at all levels of work) experienced in projects of similar size and scope. Provide list of key personnel to be responsible for each of the following aspects of work: Project Management, Technical Documentation, Control System programming, DSP programming and Leadership of Field Work (one who is present for all field work). For each identified employee, indicate number of years employed by contractor, number of years experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required.
5. Project manager assigned to this project must have a minimum of five (5) years experience in installing and integrating AV systems of similar scale. Project Manager shall also have either an INFOCOMM CTS-I or CTS-D certification.

PART 2 - PRODUCTS

2.01 GUIDELINES

- A. Infrastructure Products – All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.
- B. Performance - Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer's published specifications. Verify performance.
- C. Contract Documents - Drawings and specifications are to be used in conjunction with one another and to supplement one another. In general the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the AV system components. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed. Clarification with the owner about these items shall be made prior to the ordering and installation.
- D. Quantities – All quantities are indicated on AV drawings or in Part 2 AV Products list. Confirm quantities on final Contract Documents. If Contract Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.
- E. Small Parts - Systems are described in terms of major products. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories etc. necessary for complete and working system meeting design intent of specifications.
- F. Keys - Provide five (5) sets of keys for any AV system product requiring keys.
- G. Condition - Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.

- H. Designations - Each major product item is given unique designation (such as MIX1 for mixer number 1). The product designations are unique in this section only and may be repeated in other specification sections.
- I. Security Screws - Use Bryce Security Penta-Plus button-head screws and bits to secure rack components, LCD mounts, Projector mounts and any other location deemed necessary by Owner. Use nylon washers (not provided by Bryce) to protect equipment surfaces. Account for appropriate tip wear when ordering quantity and do not use a bit beyond the manufacturer's recommendations. Provide ten (10) additional unused driver bits and deliver to the customer after completion.
- J. AV Electrical Power - Coordinate with Electrical Contractor regarding proper placement of isolated-ground duplex outlets for any AV equipment. Electrical circuits should be connected (and outlets wired) by the Electrical Contractor to the AV system circuit breaker panel (N.I.C.). Ensure that "Star" ground configuration is properly implemented by the Electrical Contractor. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.
- K. AV Screens – For any screen specified, size as indicated in drawings. Unless otherwise indicated in drawings or specifications, set limits so projected images are 48" above finished floor, and include additional black drop as appropriate considering screen size and mounting height.
- L. AV Racks:
 - 1. Provide blank faceplate in any area marked BLANK in drawings.
 - 2. Provide shelf for mounting of any device for which rack mount kit is not available.
 - 3. Provide one (1) Panelcrafters DATCO-XXXXX-RHIM-01 designer/integrator information plate or approved alternate per rack. Install information plate at the top of each rack unless 1RU space is not available. Contact Panelcrafters sales department to add AV Contractor graphic to the "integrator" section (approximately 8.5" x 1.75" of the right-hand side). All alternates must include AV Consultant graphic. Submit to AV designer for approval of final plate design prior to purchasing and installation.
- M. AV Floor Boxes:
 - 1. Clean floor boxes of all dust and debris prior to installation of any active or connectorized plate.
 - 2. Any floor box with active or connectorized AV plates found to have any dust, debris or water in bottom of box are subject to replacement of all plates and components. A re-test of all associated components must be completed.
- N. Wireless Microphones - Coordinate frequency selection with other radio-frequency sources in the area and with manufacturer's recommendations.
- O. Control System Programming:
 - 1. Program each panel to provide simple, intuitive control of all basic AV functions including:
 - a. program and speech volume levels
 - b. video source and destination routing
 - c. screen control
 - d. video projector lift control (where applicable)
 - e. AV system power
 - f. media player transport functions
 - g. video conferencing CODEC controls including call initiation (where applicable)
 - h. video conferencing PTZ camera control (where applicable)
 - i. combine/uncombine settings for all combinations of controlled rooms
 - j. local lighting and blackout shade controls (where applicable)
 - 2. Utilize AVIXA's "Dashboard for Controls" concept and Crestron's SMART GRAPHICS for touch panel layout unless directed otherwise by Owner.
 - 3. Provide layout of each and every touch panel and hard-button panel pages in the product data submittal for approval by Owner.

4. Provide web-control for each touch panel in AV system. Include page tracking, and track current button feedback between touch panel and web-control panel.
 5. Staff member certified by control system manufacturer shall program control system.
 6. After programming is approved, all control system code and programming, including touch panel code and graphics, will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.
 7. Provide follow up meeting with Owner after 6 months of operation to make updates as requested to control programming.
- P. Audio System Programming - Owner shall coordinate layout and logical branching of DSP audio system. Include screen layout and menu branching drawings in AV submittal. After AV system is approved, all audio control system code and programming will become property of Owner. AV Contractor shall provide Owner both raw and compiled code on CD-R disc.
- Q. AV Design Substitutions: See Section 01 6000 – Product Requirements, for substitution procedures.

2.02 ROOM DESCRIPTIONS

- A. Multi-function Rooms 110
1. Rooms are physically and functionally divisible.
 2. Partition sensor to automatically change AV Systems functionality to match physical configuration.
 3. Two (2) large wall mounted flat panel displays.
 4. Control system with wired touch panels at lecterns.
 5. Sound system with ceiling mounted loudspeakers for program audio and speech re-enforcement.
 6. One (1) handheld and one (1) body worn wireless microphone per room.
 7. Audio, video and computer input connectors in lecterns.
 8. Bluetooth audio connectivity.
 9. PTZ camera mounted at each display.
 10. Ceiling mounted beam forming microphone.
 11. AV Bridge to facilitate UC via OFE computer provided for each room.
 12. 44RU AV equipment rack located in Storage 111.
- B. Conference 300 & Collaboration Space 403
1. One (1) wall mounted flat panel display.
 2. Flat panel display loudspeakers will serve program audio.
 3. Control system with wired touch panel at wall.
 4. Audio, video and computer input connectors at wall below work surface.
 5. All-in-one UC camera device at display.
- C. Waiting 102
1. Two (2) wall mounted flat panel displays with integrated tuner.
 2. One (1) partial height wall mounted flat panel display with integrated tuner.
 3. Infrastructure to support an AccentHealth PatientPoint display.
 4. Digital Signage player.
 5. CATV connectivity.
- D. Break Room 232
1. One (1) wall mounted flat panel display with built-in tuner.
 2. CATV connectivity.
- E. Dental TRT 1/409, 2/410, 3/411, 4/412 & 5/413
1. One (1) OFE medical device display mounted from above on articulating arm.
 2. Blu-ray player located at Dental work station.
 3. Cabling connecting OFE computer and blu-ray player to OEF display.

- F. Pediatric Dental 418
 - 1. One (1) OFE medical device display mounted from above on articulating arm per treatment area.
 - 2. Blu-ray player located at Dental work station. Qty. four (4).
 - 3. Cabling connecting OFE computer and blu-ray player to OEF display. Qty. four (4).

2.03 AV PRODUCTS – ACTIVE EQUIPMENT

- A. The following are major active products for this project.
 - 1. AMP (Power Amplifier) Extron XPA 2002 two channel amplifier.
 - 2. AMX (Audio Mixer) Radio Design Labs STD-MX2
 - 3. AVP (AV Wall Plate) PanelCrafters PC-G1790-E-P-C HDMI female pass through plate or similar.
 - a. Coordinate finish with architect.
 - 4. BRP (Blu-ray Player) LG BP175 or similar.
 - 5. CAM (PTZ Camera)
 - a. Type 1: Vaddio RoboSHOT 12 UHD OneLINK Bridge System camera
 - 2) Provide Chief
 - b. Type 2: Poly Studio
 - 1) Provide Poly Display Mount
 - 6. CP (Control Processor) Crestron CP4N
 - a. Connect all control processors to building network, and coordinate with Owner to acquire and configure network properties for each processor.
 - 7. DSP (Digital Signal Processor) Biamp TeseriaForte DAN VT mixer/digital signal processor.
 - a. Provide VoIP connection and coordinate with Owner to acquire IP address and configure Network appropriately.
 - 8. DWP (Dante Wall Plate) QSC Attero tech unA6IO-BT
 - 9. FPD (Flat Panel Display)
 - a. Type 1: Viewsonic CDE7520-W 75" UHD display or similar.
 - 1. Provide Chief XSM1U wall mount
 - b. Type 2: Viewsonic CDE5010 50" UHD display or similar
 - 1. Provide Chief MTM1U wall mount
 - c. Type 3: Viewsonic CDE6520-W 65" UHD display or similar
 - 1) Provide Chief MTM1U wall mount.
 - d. Type 4: Panasonic TH-65CQ1U 65" LED TV or similar
 - 1) Provide Chief RMF2 wall mount.
 - e. Type 5: Panasonic TH-55CQ1U 55" LED TV or similar
 - 2) Provide Chief RMF2 wall mount.
 - f. Provide 3 year commercial warranty on all Contractor provided displays.
 - 10. FRK (Free-standing Equipment Rack) Middle Atlantic BGR-4532 equipment rack.
 - a. Provide BFD45 solid front door.
 - b. Provide BSPN-45-32 pair of steel side panels.
 - c. Provide BGR-RDC45 rear access door.
 - d. Provide CBS-BGR caster base.
 - e. Provide BGR-552FT-FC fan top.
 - f. Provide BR-1 brush grommet panel
 - g. Provide SS extension shelf with position locking.
 - h. Provide D4 heavy duty storage drawer.
 - i. Provide one (1) Middle Atlantic TEMP-DC digital thermometer with 3-foot probe per rack. Mount thermometer display at front of rack and place probe at center of rack near amplifiers.
 - j. Provide power strip(s) for appropriate power distribution.
 - k. Provide and install new blank and vent panels to match equipment rack. Fill rack spaces reserved for future equipment with blank panels.
 - l. Provide shelf for mounting of any device for which rack mount kit is not available.

11. LAS (Assisted Listening System) Listen Technologies LS-100-01-GY
 - a. (1) LT-82 with LA-326 Universal Mounting Kit
 - b. (1) LA-140 Stationary IR Radiator
 - c. (3) LR-42 IR Stethoscope 4-Channel Receiver
 - d. (1) LR-44 IR Lanyard 4-Channel Receiver
 - e. (1) LA-166 Neck Loop
 - f. (1) LA-165 Stereo Headphones
 - g. (4) LA-363 High Capacity AAA Alkaline Batteries (2)
 - h. LA-304 Assistive Listening Notification Signage Kit
12. M (Ceiling Mounted Beam Forming Microphone) Shure MXA710W-2FT
 - a. Coordinate finish with architect.
13. MSW (Matrix Switcher) Crestron DM-MD8X8-CPU3
 - a. Provide Crestron input cards as indicated on drawings.
 - b. Provide Crestron output cards as indicated on drawings.
 - c. Connect all control processors to building network. Coordinate with Owner to acquire and configure network properties for each processor.
14. NWS (DANTE Network Switch) CISCO SG200-08 8-port Gigabit Smart Switch
15. PS (Partition Sensor) Crestron GLS-PART-CN
 - a. Provide decora cover plate to match surrounding finishes.
16. PWR (Power Conditioner)
 - a. Type 1: Furman PL-8C power conditioner.
 - b. Type 2: Furman AC-215A.
17. S (Ceiling Recessed Loudspeakers) JBL Control 26CT.
18. SP (Signage Player) Keywest Breeze BRZ2-301
19. TP (Touch Panel) Crestron TSW-1070-W-S
 - a. Coordinate finish color with architect and Owner.
 - b. Provide Crestron PWE-4803RU power injector.
20. TPRX (Shielded Twisted Pair Media Receiver) Crestron DM-RMC-SCALER-C.
21. TPTX (Shielded Twisted Pair Digital Media Transmitter) Crestron DM-TX-4KZ-100-C-1G-W-T
 - a. Coordinate finish color with architect and Owner.
22. USBRX (USB Receiver with Hub) Extron USB Extender Plus R Receiver
23. USBTX (USB Transmitter) Extron USB Extender Plus D T Transmitter
24. WCP (Control Touch Panel) Crestron MPC3-201-B
 - a. Provide MPC3-101/102/201-RMB Retrofit Mounting Bracket.
 - b. Provide Crestron PWE-4803RU power injector.
 - c. Coordinate finish color with architect and Owner.
25. WM (Wireless Microphone) Shure ULXD4Q receiver
 - a. Provide one (1) ULXD2/SM58 handheld microphones and one (1) ULXD1/WL185 lavalier condenser microphones.
 - b. Provide Shure UAA864 antennae (ANT).
26. WPD (Wireless Presentation Device) Mersive Solstice Pod Gen 3 SP-8000-E5
 - a. Provide AV Agents rack mount

2.04 CABLES

- A. Interconnect Wiring – Provide and install following cable as required for connections in all areas. Meet provisions of N.E.C. Provide plenum rated cable only where required.
 1. Analog Audio Plenum Rated cable - West Penn 25452, West Penn 25291, or similar.
 2. Digital Audio Plenum Rated Cable: Belden 1505B/1506A or Plenum rated AES/EBU compliant equivalent.
 3. Analog Composite Video Plenum Rated Cable: West Penn 25806 or Belden 88281.
 4. RGBHV Plenum Rated Cable: Belden 258195, West Penn 258195 or Liberty RGB5C-SD-PLN.
 5. VGA Wall Rated Cable: C2G Flexima.

6. Control Plenum Rated Cable: West Penn D25350.
7. Loudspeaker Plenum Rated Cable: West Penn 25226B & 25227B.
8. HDMI cables: Extron HDMI Pro and HDMI Ultra series
9. Digital Media Transport Cable: Crestron DM-CBL-ULTRA-P-SPxxx.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General Guidelines

1. Quality of Work - Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.
2. Material and Labor - Provide specified products and other incidental materials, appliances, tools, and transportation required for complete and functioning systems. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge AV infrastructure system installations.
3. Documents at Job Site - Keep following documents at job site during entire construction period:
 - a. Complete Specifications and Drawings.
 - b. Approved Shop Drawings.
 - c. Approved Product Data.
 - d. Progress Set of Project Record Documents.
4. Mounting - Mount equipment and enclosures plumb and square. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.
5. Dimension Verification - Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.
6. Clean-Up - Leave project clean each day. Place debris where designated by General Contractor. Debris includes but not limited to: solder splatter, cable ends, stripped insulation, spent crimp connectors, gypsum board and ceiling tile dust, and product wrappings and cartons. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.
7. Coordinate installation of AV infrastructure and equipment with other trades in order to follow project schedule.
8. Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.

B. Labeling

1. Equipment Labels - AV Contractor shall provide engraved lamicoïd labels on front and rear of rack-mounted equipment. Mount labels plumb and square. Include schematic reference design, item name, and system or area controlled by labeled component. On program preamps and mixers, provide label for each input indicating which source is controlled by labeled channel. Unless otherwise indicated, provide permanently-mounted black labels engraved with 1/8-inch white block characters. Handwritten, self-laminating, or embossed plastic (Dymo) labels are not acceptable. Provide labels for major equipment with two (2) lines (minimum) of engraving, coded as follows:
 - a. Line 1: Generic name of device, such as MIXER AMPLIFIER.
 - b. Line 2: Schematic designation of device, such as AV-MSW-1.
2. Control Labels – AV Contractor shall provide engraved label over each user-operated control that describes the function or purpose of control. Provide label of proper size to fit available space.
3. Terminal Strip Labels - AV Contractor shall label each terminal strip with unique identification code in addition to numerical label (Cinch MS series) for each terminal. Show terminal strip codes on system schematic drawings included with Project Record Documents.
4. Rear Equipment Labels - AV Contractor shall provide adhesive label on rear of equipment where cables attach, to indicate designation of cable connected at each point.

5. Cable and Wire Labels - Label cables and wiring logically, legibly and permanently for easy identification. Labels on cables shall be adhesive strip type, covered with clear heat shrink tubing. Factory stamped heat shrink tubing may be used. Hand-written or self-laminating type labels are not acceptable.
 6. Cable Label Codes and Locations - Label each cable with unique alpha-numeric code. Locate cable designation at start and end of each cable run, within three (3) inches of termination point. For cable runs that have intermediate splice points, label cable with same designation throughout, with additional suffix to indicate each segment of run. Provide cable designation codes to schematic drawings included with Project Record Documents and Operation and Maintenance Manuals.
- C. Power and Grounding
1. Power Coordination – Coordinate final connection of power and ground wiring to rack. Electrical contractor will provide power to AV systems. Before installation, verify load requirements for systems as accepted.
 2. Bus Bars - Install 1-inch by ¼-inch copper ground bus bar, top to bottom in floor mounted AV racks. Ground and bond equipment chassis of each rack-mounted component without three-pin grounding plug to bus bars with #12 AWG insulated green wire using 6-32 or larger nuts, bolts, lock-washers, and appropriate NEMA connectors. Electrical Contractor (Division 16) shall provide and connect #4 AWG green insulated wire from Bus Bars to ground point in AV technical electrical panel.
- D. Equipment Racks
1. Ventilation - Provide ventilation adequate to keep temperature in rack below 85 degrees Fahrenheit. Use “whisper” type ventilation fans in racks, adjusted to come on when temperature in rack rises above 85 degrees Fahrenheit, only if adequate cooling cannot be provided by Owner.
- E. Wiring
1. Wiring Standards - Execute wiring in strict adherence to best AV engineering practices.
 2. Field Connection Devices - Connect cable to active components through screw terminal connections and spade lugs when appropriate. For BNC connections use three-piece, dual crimp BNC properly sized for cable with insulating bushings. Wire nut or “Skotchlock” connectors are not acceptable. Do not wrap audio cable splices or connections with adhesive backed tape. Punch connectors or telephone-style punch blocks are not acceptable anywhere in the installation unless specifically authorized by Owner.
 3. Run cable in ceiling plenums neatly parallel to building walls, supported every three feet to structure with plenum rated ties.
 4. Raceways - Run vertical wiring inside rack in Panduit (or equivalent) plastic raceways with snap-on covers, sized to allow at least 50% future wiring. Mount raceways on full length ¾-inch flat black plywood backboards, attached to rack sides. If between-rack wiring chases are provided, Panduit raceways are not required. Horizontal wiring in rack shall be neatly tied in manageable bundles with cable lengths cut to minimize excess cable slack, but still allow for service and testing. Provide horizontal support bars if cable bundles sag. Individually bundle excess AC power cable away from rack mounted equipment with plastic cable ties. Electrical tape and adhesive backed cable tie anchors are not acceptable.
 5. Accessibility - Ensure that wiring and connections are completely visible and labeled in rack. Mount termination resistors, if required, on terminal strips, fully visible and not concealed within equipment or connectors.
 6. Loudspeaker Polarity - Connect loudspeakers electrically in phase, using same wire color for loudspeaker wiring throughout project.
 7. Physical Damage Prevention - Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.
 8. Racks - Looking into the rack from the rear, locate AC power, control, data and speaker wiring on the left; line level audio, control, video, and RF wiring on the right. Keep several inches of space between power cables and other signals.

9. Other Connections - Make connections using rosin core solder or approved mechanical connectors. Where spade lugs are used, crimp properly with ratchet type crimping tool. Solder spade lugs mounted on #22 AWG or smaller cable after crimping.

3.02 STORAGE AND HANDLING

- A. Power up any electronic equipment to ensure its proper functioning before its arrival onsite.
- B. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.
- C. Schedule delivery to minimize delays in the project.
- D. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

3.03 WARRANTY

- A. See Section 01 7800 – Closeout Submittals, for additional warranty requirements.
- B. Warranty - Submit letter providing warranty covering labor and materials supplied under this contract. Bind in Operation and Maintenance Manuals. Terms as described in General Conditions. Minimum terms as follows:
 1. System - Systems shall be free of manufacturing or installation defects for a minimum period of one (1) year from the date of final acceptance. Clearly designate begin and end dates of system warranty period.
 2. Parts and Labor - Provide parts and labor to repair defects in materials and workmanship during system warranty period.
 3. Response Time - Within system warranty period, provide initial on-site service response within one (1) business day of service call. Provide resolution to any system defects within 72 hours or within 48 hours of receipt of repaired or replaced product from manufacturer.
 4. Replacement Products - If any item must be removed for repair during system warranty period, provide replacement item of similar quality at no charge.
 5. Repair Limit - Do not repair any piece of equipment found defective during installation or system warranty period more than two (2) times. After second repair, replace defective item with similar approved item at no additional cost to Owner.
 6. Extended Manufacturer's Warranties – Identify products with manufacturer's warranties extending beyond one (1) year. Provide terms and conditions of such warranties.
 7. Service Personnel Information - Provide name(s) and telephone number(s) of service personnel to be contacted regarding repair and maintenance.
- C. Extended Warranty - Provide cost to extend complete AV system warranty from one (1) year to three (3) years. Included a list of all provided services including maintenance schedules.

3.04 INITIAL TESTS

- A. Purpose – These tests are to ensure that the AV system is installed and functioning as specified, and to ensure the system is ready for Final Tests and Adjustments (described later).
- B. Testing Standards – Perform testing in accordance with ANSI standards.
- C. Inspection - Verify prior to beginning actual tests and adjustments on systems:

1. Proper grounding of all electronic components (through third prong of power connector or separate connection between component chassis and ground bus bar).
 2. Cables dressed, routed, and labeled, connected with proper polarity.
 3. Insulation and shrink tubing in place.
 4. Dust, debris, solder splatter, etc. removed.
 5. Proper frequency settings (or modules) at crossovers and controllers.
 6. All equalizer bands and tone controls set for flat frequency response.
 7. Survey temperatures of each piece of equipment after four (4) hours use (minimum). Note and report any hot equipment.
- D. Electrical Power Quality - While all sound and AV system components are unplugged from electrical power outlets, AV Contractor shall turn on power to outlets, and confirm proper voltages at each outlet across the following pairs of terminals: hot and neutral, hot and ground, and neutral and ground (zero volts across neutral and ground). AV Contractor to document measurements.
- E. General Function Tests - Test each piece of equipment to ensure that it performs its intended function. Include all portable equipment in tests. Intent of initial tests is to verify complete, functioning system before Final Tests and Adjustments. Correct problems found during initial testing before beginning Final Tests and Adjustments. Document whether all pieces performed intended functions; note any unresolved malfunctions.
- F. Initial Tests and Adjustments Data - Submit written report of Initial Tests and Adjustments data upon completion to Owner. Include printed name(s) of technician(s) performing tests, date(s) and time(s) of tests, model and serial numbers of test equipment, results of each initial test, descriptions of problems encountered and their solutions, and statement that system is ready for Final Tests and Adjustments. Initial Tests and Adjustments Data to include signatures of technician(s) performing tests.

3.05 FINAL TESTS AND ADJUSTMENTS

- A. Purpose – These tests are to be witnessed by AV Consultant to determine if system is complete and functioning as designed and specified. Also, AV Consultant will perform listening and viewing tests and witness adjustments of all images for optimum clarity.
- B. Timetable - Coordinate with Owner, General Contractor, and AV Consultant to schedule Final Tests and Adjustments after submittal of Initial Tests and Adjustments data.
- C. System and Site Conditions – AV Consultant will witness Final Tests and Adjustments. Have systems fully functional and ready for observation and testing upon AV Consultant's arrival. Coordinate with all trades for quiet conditions throughout the listening areas and for the duration of the test schedule. If upon AV Consultant's arrival, systems do not meet criteria, site is not sufficiently quiet, or if Owner or AV Consultant is required to make additional trips to job site to witness additional testing or perform additional reviews of installed equipment, Contractor shall reimburse Owner for labor and expenses incurred by having incurred costs deducted from payments to contractor.
- D. Test Labor - Provide technician familiar with this project's AV systems and operation of test equipment to perform testing. Provide additional technician to assist in the tests and to perform troubleshooting, repairs, and adjustments. Include labor for these technicians to be present for one (1), eight (8)-hour day during Final Tests and Adjustments.
- E. Tools - Provide standard hand tools including screwdrivers, pliers, wire strippers, nut drivers, soldering iron, and other tools appropriate for troubleshooting system problems.
- F. Ladders and Scaffolds - Provide ladders and scaffolds to inspect/adjust loudspeakers and rigging points.

- G. Verification of Initial Tests and Adjustments - Verify that Initial Tests and Adjustments have been performed and meet criteria. During Final Tests and Adjustments, AV Consultant may require portions of the Initial Tests and Adjustments to be repeated. Repeat measurements as requested without claim for additional payment.

3.06 FINAL ACCEPTANCE BY OWNER

- A. Certificate – Submit Certificate of Final Acceptance form signed by Owner verifying complete installation and proper operation of systems upon fulfillment of all requirements and upon recommendation by Owner.
- B. General Adjustments – Adjust, balance, and align equipment for optimum quality, meeting manufacturers published specifications.
- C. Input/Output Jack Demonstration – Demonstrate proper performance and phase of each system input and output jack (all audio input and output jacks) as received at AV and network systems.
- D. Inventory – Inventory all installed and portable equipment for correct quantities.
- E. Functional Demonstration – Demonstrate operation of each function of each major piece of equipment.
- F. Other Tests - Perform any other tests on any part of the AV system as requested by Owner.
- G. Final Equipment Settings – Record final settings of all equalizer bands, tone controls, filters, delays, limiters, etc., including those established through computer software settings. Include descriptions of settings (including software settings) in Operation and Maintenance Manual. Include software copy of configuration file(s) in Operation and Maintenance Manual.
- H. Security Inspection – Inspect equipment for security from tampering (covers, shaft-locks, etc.).
- I. Review of Labels – Review installed labels on cables, equipment, controls, and terminal strips.

3.07 OWNER TRAINING

- A. Provide Owner training as described in General Conditions. As a minimum, provide eight (8) hours instruction (within two (2) trips to site) regarding AV Systems operation to Owner-designated personnel. Schedule instruction time(s) with Owner to occur after completion of Final Tests and Adjustments. Coordinate with Owner in advance to schedule instruction time. Document date, time, and attendees of the training session and include documentation in Operation and Maintenance Manuals to serve as record of trained personnel.

3.08 SUPPORT DURING OWNER'S FIRST USE OF COMPLETED SYSTEM

- A. Provide personnel familiar with design, installation, and operation of each system to be present at Owner's first use of each completed system (up to eight (8) hours total in a single session). During first use of each system, respond to Owner requests for troubleshooting, adjustments, and additional training. If no one contractor employee or representative can provide expertise in all aspects of the system, provide multiple personnel for the eight (8) hours per session as required. Schedule presence of personnel in advance with Owner. Should significant elements of the new system be operational prior to final completion, Owner may elect to schedule contractor presence for Owner function prior to final completion of system. Should Owner exercise this option, contractor presence will not be required at first use following final completion.

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END OF SECTION

SECTION 27 41 17 - AUDIO VIDEO INFRASTRUCTURE

PART 1 - GENERAL

1.01 SUMMARY

- A. This document covers the general requirements for the installation of Audio Video (AV) Infrastructure systems at the Central Health Del Valle Health and Wellness Center in Austin, Texas.

1.02 CODES

- A. Execute work in accordance with best AV system installation practices and codes listed below.
- B. Codes and Standards (Most recent editions or as required in contract)
 - 1. ANSI/TIA-568-C: Commercial Building Telecommunications Wiring Standard.
 - 2. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. ANSI/TIA-606-A Administration Standard for Commercial Telecommunications Infrastructure
 - 4. ANSI-J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
 - 5. Underwriters Laboratories (UL) Cable Certification and Follow-Up Program
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. American Society for Testing Materials (ASTM)
 - 8. National Electrical Code (NEC)
 - 9. National Electrical Safety Code (NESC)
 - 10. Institute of Electrical and Electronic Engineers (IEEE)
 - 11. UL Testing Bulletin
 - 12. BICSI Information Transport Systems Methods Manual (ITSMM)
 - 13. Local, county, state and federal regulations and codes in effect as of date of installation
 - 14. Equipment of foreign manufacture must meet U.S. codes and standards.

1.03 REGULATIONS

- A. Comply with terms and conditions of Americans with Disabilities Act, especially regarding provisions for hearing impaired and wheelchair access in control areas.

1.04 SUBMITTALS

- A. See Section 01 3000 – Administrative Requirements, for submittal procedures.
- B. Shop Drawings
 - 1. The Contractor shall provide at least four (4) sets of Shop Drawings
 - 2. Timetable:
 - a. Submit within thirty (30) days after award of contract
 - b. Submit simultaneously with Product Data Binders.
 - c. Allow minimum of ten (10) business days for review.
 - 1. All sets minus one (1) will be returned with review comments.
 - 2. If a resubmit is required, resubmit total quantity of complete sets.
 - 3. If second resubmit is required, Contract shall reimburse Owner for expenses incurred during additional review process.
 - 3. Description:
 - a. Shop Drawings shall be used for coordination between trades and updated as final record drawings.
 - b. Bind all Shop Drawings together to form set. Loose drawings will not be accepted.
 - c. Each drawing shall include:
 - 1. Project

2. Building
 3. Location
 4. Contractor Name
 5. Architect
 6. AV Consultant
 7. Date and Revision Number
 - d. Number and title each drawing in logical manner as a set.
 - e. Include cover sheet with listing of all drawings included in bound set.
 - f. Ensure that labeling on Shop Drawings match labeling on equipment.
 - g. Minimum Scale:
 1. Floor Plans: 0'-1/8" = 1'-0"
 2. Rack Elevations: 0'-1.5" = 1'-0"
 3. Details: 0'-6" = 1'-0"
 4. Shop Drawings shall include
 - a. Floor plans shall indicate locations of all AV devices, vertical risers, pull boxes, and exposed wiring.
 1. Include Device ID (PRJ, SCREEN, FRK, FB, AVP, etc., as referenced in design contract documents), as appropriate for projectors, screens, racks, floor boxes, AV plates in walls, etc.
 - b. Electrical power wiring diagram.
 1. Include circuit, switching, and control details.
 - c. Wiring diagram of grounding and shielding scheme.
 - d. Drawings for custom-fabricated items:
 1. i.e., plates, panels, cables, and assemblies
 - e. General construction drawings necessary for completion of work.
 - f. Mounting detail drawings of loudspeakers, racks, and overhead equipment.
 5. Hire services of professional structural engineer, licensed by the appropriate governing authority, to review shop drawings, building structural drawings, and any existing structures from which equipment is to be suspended.
 - a. Include Structural Engineer's stamped report with shop drawing submittal. Report shall include:
 1. Itemization of items reviewed by the Structural Engineer.
 2. Confirmation that proposed methods of suspending equipment as shown on the shop drawings conform to required safety factors.
 3. Confirmation that building structure from which equipment is to be suspended will support equipment including required safety factors.
- C. Samples
1. Request for Samples
 - a. Upon request, furnish samples (at no additional cost) to Owner and/or General Contractor of submitted items proposed as substitutes for specified items.
 - b. Products will be reviewed to determine if proposed substitute items meet required function and quality.
 2. Product Tests
 - a. Products submitted as samples may require testing by independent laboratory.
 1. Testing at expense of Contractor
 - b. Obtain written approval of tested products before incorporating into system.

1.05 QUALITY ASSURANCE

- A. AV Contractor Qualifications
 1. The AV System Contractor shall be regularly engaged in furnishing and installing AV systems.

- a. Electrical or general contracting firms responsible for completion of this work, but not meeting above requirement, shall employ services of approved AV Contractor as subcontractor to perform work described herein.
2. The AV System Contractor shall have installed AV systems of similar size and scope within last five (5) years.
 - a. Submit list of four (4) (minimum) installed jobs of similar magnitude, completed within last five years.
 - b. For verification, submit complete information, including project name, project address, contact person, daytime telephone number plus month and year of project completion.
 - c. At Owner's request, accompany Owner or Owner's representative on visit to any or all example completed projects submitted.
3. The AV System Contractor shall be an Authorized Dealer for all major components of the AV equipment specified.
 - a. Must have at least one permanent staff member who is factory trained in the installation and maintenance of each major product line offered.
4. Employ personnel (at all levels of work) experienced in projects of similar size and scope.
 - a. Provide list of key personnel to be responsible for each of the following aspects of work including:
 1. Project Management
 2. Technical Documentation
 3. For each identified employee, indicate number of years employed by contractor, number of years experience in assigned responsibilities, and list of previously completed projects where similar responsibilities were required.
 - b. Project manager assigned to this project must have a minimum of five (5) years experience in installing and integrating AV systems of similar scale.

PART 2 - PRODUCTS

2.01 GUIDELINES

- A. Infrastructure Products
 1. All conduits, basket tray/cable tray, pull boxes and associated parts required for infrastructure shall be installed by the electrical contractor unless specifically excluded in these specifications or drawings.
- B. Performance
 1. Regardless of completeness of descriptive paragraphs herein, each device shall meet its manufacturer's published specifications and verified.
- C. Contract Documents
 1. Drawings and specifications are to be used in conjunction with one another and to supplement one another.
 - a. In general, the specifications determine the nature and quality of the materials, and the drawings establish the quantities, details, and give characteristics of performance that should be adhered to in the installation of the AV system components.
 - b. If there is an apparent conflict between the drawings and specifications, the items with the greater quantity or quality shall be provided and installed.
 - c. Clarification with the owner about these items shall be made prior to the ordering and installation.
- D. Quantities
 1. Confirm quantities on final Contract Documents.
 2. If Contract Documents do not include quantities necessary to deliver complete working system, provide notification of disparity, and install required quantity of devices for complete working system.
- E. Small Parts

1. Systems are described in terms of major products.
 2. Even if not specifically mentioned, provide and install patch cables, connectors, hardware, converters, power supplies, labels, terminals, mounting accessories etc. necessary for complete and working system meeting design intent of specifications.
- F. Keys
1. Provide five (5) sets of keys for any AV system product requiring keys.
- G. Condition
1. Provide and install products listed in this section in factory new condition, conforming to applicable provisions of American National Standards Institute.
- H. Designations
1. Each major product item is given unique designation (such as MIX1 for mixer number 1).
 2. The product designations are unique in this section only and may be repeated in other specification sections.
- I. Security Screws
1. Use Middle Atlantic HSK screws and bits to secure rack components, LCD mounts, Projector mounts and any other location deemed necessary by Owner.
 2. Use nylon washers to protect equipment surfaces.
 3. Account for appropriate tip wear when ordering quantity and do not use a bit beyond the manufacturer's recommendations.
 4. Provide ten (10) additional unused driver bits and deliver to the customer after completion.
- J. AV Electrical Power
1. Coordinate with Electrical Contractor regarding proper placement of isolated-ground duplex outlets for any AV equipment.
 2. Electrical circuits should be connected (and outlets wired) by the Electrical Contractor to the AV system circuit breaker panel (N.I.C.).
 3. Ensure that "Star" ground configuration is properly implemented by the Electrical Contractor.
 4. Ensure that ground wires from each outlet are isolated from conduit, neutrals, and each other.
- K. AV Screens
1. Unless otherwise indicated in drawings or specifications, set limits so projected images are 48" above finished floor in meeting rooms and board room and 60" above finished floor in the multi-purpose room, and include additional black drop as appropriate considering screen size and mounting height. Ensure screens clear marker boards/ whiteboards, pen trays and all other wall protrusions.
- L. AV Floor Boxes
1. Clean floor boxes of all dust and debris prior to installation of any active or connectorized plate.
 2. Any floor box with active or connectorized AV plates found to have any dust, debris or water in bottom of box are subject to replacement of all plates and components.
 - a. A re-test of all associated components must be completed.
- M. Substitutions: See Section 01 6000 – Product Requirements, for substitution procedures.

2.02 AV PRODUCTS

- A. The following are major active and infrastructure products for this project.
1. FPD TYPE 1 (Flat Panel Pull Box)
 - a. Chief Manufacturing PAC526FCW in-wall pull box
 2. FPD TYPE 2 (Flat Panel Pull Box)
 - a. Chief Manufacturing PAC526FCW in-wall pull box

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General Guidelines
 - 1. Quality of Work
 - a. Perform labor to accepted industry standards and state and local codes to accomplish complete and working system.
 - 2. Material and Labor
 - a. Provide specified products and other incidental materials, appliances, tools, and transportation required for complete and functioning systems.
 - b. Provide personnel to perform labor who are skilled in techniques and can demonstrate technical knowledge AV infrastructure system installations.
 - 3. Documents at Job Site
 - a. Keep following documents at job site during entire construction period:
 - 1. Complete Specifications and Drawings
 - 2. Approved Shop Drawings
 - 3. Approved Product Data
 - 4. Progress Set of Project Record Documents
 - 4. Mounting
 - a. Mount equipment and enclosures plumb and square.
 - b. Ensure that permanently installed equipment is firmly and safely held in place. Design equipment supports to support loads imposed with project safety factor of five (5) or greater.
 - c. For devices hung overhead, obtain review by Structural Engineer licensed by the appropriate governing authority prior to installation.
 - 5. Dimension Verification
 - a. Verify dimensions and space requirements to assure that proper mounting, clearance, and maintenance access space is available for system components.
 - 6. Clean-Up
 - a. Leave project clean each day
 - b. Place debris where designated by General Contractor.
 - c. Debris includes but not limited to:
 - 1. Solder splatter
 - 2. Cable ends
 - 3. Stripped insulation
 - 4. Spent crimp connectors
 - 5. Gypsum board and ceiling tile dust
 - 6. Product wrappings and cartons
 - d. After completion of installation, thoroughly clean areas worked, including non-visible areas such as equipment rack interiors, rack top panels, and inside lockable floor and wall boxes.
 - e. Coordinate installation of AV infrastructure and equipment with other trades in order to follow project schedule.
 - f. Maintain any licensing required by the appropriate governing authority to install and terminate low voltage systems.
- B. Power and Grounding
 - 1. Power Coordination
 - a. Coordinate final connection of power and ground wiring to rack.
 - b. Electrical contractor will provide power to audio video systems.
 - c. Before installation, verify load requirements for systems as accepted.
 - 2. Bus Bars
 - a. Install 0'-1" X 0'-1/4" copper ground bus bar, top to bottom in floor mounted AV racks.

- b. Ground and bond equipment chassis of each rack-mounted component without three-pin grounding plug to bus bars with #12 AWG insulated green wire using 6-32 or larger nuts, bolts, lock-washers, and appropriate NEMA connectors.
- c. Electrical Contractor (Division 26) shall provide and connect #4 AWG green insulated wire from Bus Bars to ground point in AV technical electrical panel.

C. Wiring

1. Physical Damage Prevention

- a. Take necessary precautions to prevent physical damage to cables and equipment. Damaged cables or equipment will not be accepted.
- b. Separate, organize, and route cables to restrict channel crosstalk and feedback oscillation.

3.02 STORAGE AND HANDLING

- A. Power up any electronic equipment to ensure its proper functioning before its arrival onsite.
- B. Ensure that materials (especially electronic and electro-acoustic devices) are protected against physical, environmental, and electronic damage until final acceptance by Owner.
- C. Schedule delivery to minimize delays in the project.
- D. Provide storage protection against temperature and humidity extremes, theft, vandalism, physical damage, and environmental damage.

3.03 WARRANTY

- A. See Section 01 7800 – Closeout Submittals, for additional warranty requirements.

3.04 CLOSEOUT

- A. See Section 01 7800 – Closeout Submittals, for additional requirements.

END OF SECTION 27 4117

SECTION 28 00 00 – ELECTRONIC SECURITY

PART 1 GENERAL

1.01 PROJECT SUMMARY/OVERVIEW

- A. This document covers the general requirements for work to be performed to provide electronic security and surveillance.
- B. The contents of this document, along with related drawings and other documentary material, are critical to the security of this project and Owner and shall remain secure and confidential.
 - 1. Confidential information shall not be deliberately or inadvertently disclosed to anyone other than the Contractor's personnel and subcontractors who require disclosure to perform their portion of the work.
 - 2. This confidential information shall be tracked to ensure that copies are accounted for and properly destroyed when no longer needed to perform the work.
- C. The security systems shall consist of the following integrated subsystems as specified herein:
 - 1. Electronic Access Control and Intrusion Detection
 - 2. Video Surveillance
 - 3. Wire and Cable
- D. Provide complete turnkey systems with the exception of those items noted within this specification as being provided by others.
- E. Related Sections include:
 - 1. Section 087100 Door Hardware
 - 2. Section 260000 Electrical (including related sub-sections)
 - 3. Section 270000 Communications (including related sub-sections)
 - 4. Section 281000 Electronic Access Control and Intrusion Detection
 - 5. Section 282300 Video Surveillance
 - 6. Section 283100 Fire Alarm and Smoke Detection

1.02 GENERAL REQUIREMENTS

- A. Upon completion of commissioning testing and Owner acceptance, DataCom Design Group bears no liability or responsibility for the continued proper operation of the installed systems.
- B. The Items described herein shall not be modified or substituted without consent of DataCom Design Group and/or the Owner.
- C. Electronic security systems integrator (security subcontractor) manager/supervisor shall attend meetings arranged by the Contractor, Architect, Owner or other parties affected by the work of this Section 280000.

- D. If the manufacturer of security devices or connecting hardware has supplied post manufacture performance data, copies of such are to be kept for inclusion in the documentation and made available to the Owner upon request.
- E. All materials are to be new unused and of the latest series of model number, unless otherwise indicated by the Owner or security system designer.
- F. All materials shall be rated for the environment they are installed.
 - 1. All materials shall be UL- and/or ETL-approved and labeled in accordance with NEC for all products where labeling service normally applies.
 - 2. Materials and equipment requiring UL 94, 149 or 1863 listing shall be so labeled.
 - 3. Modification of products that nullifies UL labels is not permitted.
- G. All security integrator personnel must be manufacturer certified and capable of an installation that falls under the manufacturer's guidelines necessary to obtain a manufacturer warranty.
 - 1. The integrator shall provide all components/materials essential for a complete and functional security access and surveillance system.
- H. Security integrator shall issue a two (2) year warranty on installation and workmanship.
- I. These Specifications and Drawings are intended for bidding purposes only, No part shall be copied or used for any purpose other than bidding on this project.
 - 1. This package shall be contractual upon bid award.
- J. Drawings and Specifications are to be used in conjunction with one another and to supplement one another.
 - 1. In general Specifications determine the nature and quality of the materials and tests, and drawings establish the quantities, details and give characteristics of performance that should be adhered to in the installation of the security system components.
 - 2. If there is an apparent conflict between the drawings and specifications, or within the specifications themselves, the items with greater quantity or quality shall be estimated and installed.
 - 3. Clarification with the Owner/Designer about these items shall be made prior to purchase and installation.
 - 4. Questions regarding the Specification or system requirements should be directed in writing to DataCom Design Group or the Owner.
- K. Security integrator shall adhere to Division 1 general requirements and written security Specifications and Drawings within this construction package and shall be responsible for complying with all local, state and federal laws or regulations applicable to the work being performed, even though said law, rule or regulation is not identified herein.
- L. Security integrator shall arrange and pay for any inspections required by the public agencies having jurisdiction in the area.

- M. The security contractor shall procure and maintain for the duration of this agreement, insurance against claims for injuries to persons or damages to property which may arise from, or conjunction with, the performance of the work hereunder by the security integrator, his agents, representatives, or employees.
 - 1. The security integrator shall pay the cost of such insurance.
- N. The security integrator will respect and protect the privacy and confidentiality of the Owner, his employees, processes, products, and intellectual property to the extent necessary, consistent with the legal responsibilities of the State of Texas and the Owner.
- O. If required the security integrator shall sign a non-disclosure agreement and abide by its requirements to keep confidential all information concerning bid documents and this Project.
- P. Furnish submittals and manuals in accordance with Division 1.
- Q. Furnish a detailed material list complete with suppliers (distributors) list of components and distributors name, address, and phone number.
- R. Refer to Specifications issued by Architect, Division 1, for Project and cost payments.

1.03 REFERENCES

- A. The publications listed below form a part of this Specification. The publications are referred to in the text by basic designation only.
- B. Specific reference in Specifications to codes, rules, regulations, standards, manufacturer's instructions, or requirements of regulatory agencies shall mean the latest printed edition of each in effect at the date of contract unless the document is shown dated.
- C. For conflicts between referenced requirements and contract documents comply with the one that is more stringent.
 - 1. Federal, State, and Local codes, regulations and ordinances
 - 2. NFPA 101: Life Safety Code
 - 3. NFPA 72: National Fire Alarm Code
 - 4. NFPA 730: Guide for Premises Security
 - 5. NFPA 731: Standard for the Installation of Electronic Premises Security
 - 6. National Electric Code (NEC), latest edition
 - 7. Building Codes (UBC) (IBC), latest editions
 - 8. Occupational Health and Safety Act (OSHA)
 - 9. Americans with Disabilities Act (ADA)
 - 10. Local Governing Authorities Having Jurisdiction
 - 11. Underwriters Laboratory (UL) Applicable Standards for Safety and Security
 - 12. Institute of Electrical and Electronics Engineers (IEEE) Applicable Standards
 - 13. Telecommunications Industry Association (TIA) Applicable Standards
- D. Related Documents

1. Security Drawings
2. General provisions of contract
3. Uniform general conditions
4. Supplementary general conditions
5. Architectural plans & specifications
6. Requirements of Division 1
7. Electrical / Mechanical / Telecommunications specifications and plans.

1.04 DESCRIPTION OF SYSTEM WORK

A. Furnish and install all materials, tools, equipment, and services for all electronic security/surveillance devices to provide functioning systems in accordance with performance requirements specified and any modifications resulting from reviewed shop and field coordinated drawings.

1. Access Control System

- a) This system replaces the typical mechanical key controlled door lock with a door locking system that uses an access card as the access credential.
- b) The system includes an electric door-locking mechanisms, card reader located adjacent the door, door status sensor, door prop alarm and a request to exit device.
- c) Typical system configuration is card or schedule controlled entry with free exiting.

2. Intrusion Detection System

- a) This system monitors areas for unauthorized entrance or intruder.
- b) This system can consist of motion sensors, door status sensors, glass break sensors and one or more control keypads.
- c) The keypad is used to arm/disarm system by entering a numeric code on the keypad.

3. Video Surveillance System

- a) This system is used to provide video surveillance through the use of cameras of security sensitive areas and target items.
- b) The system shall allow for the viewing and recording of images.

B. RACKS AND ENCLOSURES

1. Wall mounted enclosures, data gathering panels, and power supply panels shall be installed as per manufacturer's requirements.

- a) Coordinate pathways and power with Electrical and Telecommunications Contractors

- b) Furnish all labor, materials, tools, equipment, and services for all control consoles, equipment racks, cabinets, and enclosures not provided by others in accordance with contract documents.
 - c) Completely coordinate with work of other trades to avoid duplication in purchasing.
 - d) Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.
2. The installation of the relay racks/cabinets for Electronic Surveillance shall be by the Telecommunications Contractor.
3. The designated security space will provide an area reserved for rack and wall mounted security equipment.
- a) The rack area allows for vertical relay rack(s).
 - b) Backboard wall area of 8'-0" X 8'-0" shall be reserved for wall-mounted components.
 - c) Cable tray/ ladder shall be by the telecommunications contractor and is provided to facilitate cable access into both wall and rack mounted equipment.
- C. Provide all supplementary or miscellaneous items and devices incidental to or necessary for a sound and complete installation.
- D. Drawings are representative and show general arrangement of systems and equipment, except when dimensioned or detailed.
- 1. For exact locations refer to dimensioned architectural drawings.
 - a) Field measurements take precedence over dimensioned drawings.
 - b) Field verify locations and arrangement of all systems and equipment.
 - c) Coordinate all work with other trades and Contractor.
- E. Circuit Supervision
- 1. Supervise all signal and data transmission lines, links with other systems, and sensors.
 - a) Indicate circuit and detection device faults with both protected zone and trouble signals.
 - b) Initiate an alarm in response to opening, closing, or shorting of a signal or data transmission line.

- F. Electronics systems work as specified in this Section and Sections 281000 and 282300, shall include:
1. A project kick-off/pre-submittal meeting with the Architect, Designer, and Contractor to review security design package.
 - a) Additional participants shall include:
 - 1) Division 8 subcontractors
 - 2) Division 26 subcontractors
 2. Preparation of pre-installation submittals, including point-to-point wiring information for security equipment to interface to work by others prior to start of any installation work. Include lock permit requests in submittals for review.
 3. Furnishing and installation of all security devices, components and accessories.
 4. The furnishing and coordination on installation of special back boxes for security equipment and field devices as required.
 5. Furnishing, installation and termination of all copper wiring and cabling including any special purpose wire and cable for electronic security systems.
 - a) Coordinate all network and fiber optic cable interface provided by telecommunications subcontractor.
 6. Coordinate raceway and power distribution systems provided by Division 26.
 7. Provide and install 12/24 VAC/DC input power to all field devices as required.
 8. Coordination with other trades and Owner required to facilitate the installation of the security equipment including:
 - a) Division 08 (doors)
 - b) Division 26 (power, raceways, and fire alarms)
 - c) Division 27 (telecommunications network interface).
 9. Wiring and termination of electrified door hardware by security subcontractor shall be concurrent with the installation of these electrified components by the door hardware subcontractor.
 10. Programming of all security control equipment and prior coordination with the Owner's security and telecommunications personnel.
 11. Preparation of "As-Built" documentation.
 12. Warranty service for completed work.

1.05 SUBMITTALS

- A. Refer to Requirements of Division 1.
- B. Pre-Installation Submittal Requirements
 1. Submittals for electronic security shall be complete and submitted at the same time.

- a) No partial submittals will be accepted for review.
- b) Allow 2 weeks for consultant review of submittals.

2. General Requirements

- a) A functional description of each system.
- b) All cable and wiring types for each device type used.
- c) Written confirmation that lock wiring and access control systems requirements have been coordinated with electrified door hardware, fire alarm systems, automatic door controls, and overhead door controls specified in other sections and other packages.
- d) Power supply points listing with devices and maximum loads to prevent overloading.
- e) Battery backup calculations to show load and back-up times for UPS and power supplies with batteries.
- f) Equipment schedules listing all system components, manufacturer, model number and quantities of each.
- g) Qualifications and proof of work history (with references).

3. Product Data Cut-sheets

- a) Complete manufacturer's technical data including manufacturer warranty information, descriptive literature, illustrations, and installation instructions for all components included within this project indicating compliance with applicable referenced standards, size, dimensions, model number, electrical characteristics, support requirements, connection requirements and all applicable information verifying that submitted components comply with Contract Documents.

4. Shop Drawings

- a) Floor plans necessary to identify specific device locations, cable routes and quantities, cable types, riser locations, and references to installation details and diagrams.
- b) Riser diagram showing routes between floors or other areas that are not easily identified on the floor plans.
- c) Security One-line diagrams showing all input and output points of the system.
 - 1) The Contractor shall make any corrections required by the consultant team, file with him two corrected copies and furnish such other copies as may be needed.

- 2) The consultant's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from drawings or specifications, unless he has in writing called the Architect's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.
 - d) Release of CAD Files
 - 1) Contractor may request to utilize DataCom's AutoCAD floor plan files for assistance in producing shop drawings.
 - 2) Request shall be made by signing DataCom's "Agreement for Release of CAD Files" letter.
 5. Warranty
 - a) The Contractor shall provide the appropriate documentation to comply with the requirements described in the WARRANTY section.
 6. Qualifications
 - a) The Contractor shall provide the appropriate documentation to comply with the requirements described in the QUALITY ASSURANCE section.
- C. As-Built drawings shall be in current AutoCAD format, same version as used by the Architect.
1. Dimensions and scale of the drawing sheets submitted shall match the size of the drawing used for the contract documents, and shall include the following.
 - a) Utilize normally recognized drafting procedures that match AutoCAD standards, Architect, and Designer guidelines and methodology.
 - b) The As-Built drawings shall incorporate all changes made to the building identified in, but not limited to, Addenda, contemplated change notices, Site Instructions or deviations resulting from site conditions.
 - c) Dimensioned plan and elevation views of all security components.
 - d) Cable routing paths of security cables to identified infrastructure pathways.
 - e) All rack, cabinet, and enclosure locations and labeling thereof.
 - f) One-line diagrams of equipment/device interconnecting cabling of the security systems.
 - g) Standard or typical installation details of installations unique to Owner's requirements.
 - h) Submit one soft and one hard copy with project deliverables within 30 days of project completion.

- D. Security integrator shall provide three (3) paper copies and one (1) electronic copy (PDF format) of a properly indexed O&M Manual at the conclusion of the project, which will include, but not be limited to the following requirements:
1. Ring binder with project title, properly indexed, and contractor's name on cover and spine including:
 - a) Sequence of operations, design philosophy, and specific functions
 - b) System block diagram
 - c) Equipment list including:
 - 1) A brief description
 - 2) Model
 - 3) Total number of each item used in the project.
 - d) Camera schedule including:
 - 1) Number
 - 2) Location
 - 3) Camera model/manufacture
 - 4) View
 - 5) Lens
 - 6) Power source
 - 7) Multiplexer/input
 - 8) Settings entered on site
 - e) Manufacturers' data sheet and O&M manual for associated equipment.
 - f) Maintenance requirements for equipment, inspections and preventative maintenance schedules.
 - g) As-built drawings for each floor plan layout and rack and wall elevation layouts. Each drawing shall show:
 - 1) Cable type and identifier
 - 2) Actual cable routing pathway
 - 3) Device number (camera, etc.),
 - 4) Device input/output number.
 - h) Final test data (measured video levels, day & night camera snapshots in JPEG format and other significant operating parameters).
 - i) List of system associated mechanical locking keys with key codes and tamper resistant hardware types.

1.06 QUALITY ASSURANCE

- A. Electronic security systems integrator (security subcontractor) shall meet the following minimum requirements.

1. Maintain a valid Type B license from the Texas Private Security Bureau.
 2. Maintain a valid UL 2050 certification for electronic security systems.
 3. Have successfully completed three (3) projects of similar size and complexity that have been in proper operation for a period of one (1) year.
 4. Technicians shall be factory trained and certified in specified systems.
 5. The Project manager and supervising/lead technician shall have been regularly engaged in the installation and testing of the products specified for not less than five (5) years and maintain manufacturer certification.
 6. The security integrator must maintain an operating facility in the local area (50 mile radius) of the Project location to provide service to the Owner for the warranty period.
 - a) At the Owners request for service, the security integrator shall dispatch a service technician to the location to affect the required repairs or adjustments.
 7. The contractor shall maintain a spare parts inventory necessary to resolve component failures of the system.
 - a) Refer to individual specification section for a list of specifically required parts provided to the owner and stored on site. These parts will become the property of the owner.
 - 1) At the end of the warranty period the security integrator shall test the owner's spare parts and repair or replace as needed to bring the parts up to proper operation.
- B. Security integrators desiring approval must comply with Division 1 requirements.
- C. Security integrator must be cognizant of site conditions, verify locations of new and existing equipment, and determine exact requirements for connection and interface.

1.07 PRE-INSTALLATION MEETINGS

- A. Attend and/or arrange a scheduled pre-installation conference prior to beginning any work of this section.
1. Agenda
 - a) This venue is to ask and clarify questions in writing related to work to be performed, scheduling, and coordination with the Project manager/Owner representative and consultant.
 2. Attendance
 - a) The security project manager/supervisor shall attend meetings arranged by General Contractor, Owner's representatives, and other parties affected by work of this document.
 - b) All individuals who will be installers of the electronic security system and equipment in an on-site supervisory capacity, including project managers

and lead installers, shall be required to attend the pre-installation conference.

- c) Individuals who do not attend the conference will not be permitted to install, or supervise the installation of, any component of the security system.
 - 1) This includes supervisors, project managers, and lead installers of this project.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Equipment and components shall be delivered properly protected and undamaged with original containers, packaging, and labels intact.
- B. Store, handle, and protect all related materials and equipment in accordance with Manufacturer's recommendations.
- C. Provide additional protection during handling as necessary to prevent breaking, scraping, marring, or otherwise damaging products or surrounding areas.
- D. Equipment and components shall be protected from the weather, humidity, temperature variations, dirt, dust, or other contaminants.
 - 1. Equipment damaged prior to system acceptance shall be replaced at no cost to the owner.
- E. Protect all equipment and components that are to be installed from theft, vandalism, or use by unauthorized persons.

1.09 PROJECT/SITE CONDITIONS

- A. Security integrator is responsible for conducting a site survey prior to the commencement of work to determine locations of all existing security devices and verify the proposed locations of the new components to be installed.
- B. Security integrator will coordinate all work through the Contractor and schedule work to cause as little interference or interruption of existing services as possible.
- C. Security integrator will arrange and pay for all necessary permits, licenses, and inspections.
 - 1. Security integrator shall prepare all information necessary to obtain a permit for Electronic Locking Mechanisms in compliance with the Owner requirements.
- D. Verify with Division 26 installer all conduits and special back box requirements in a timely manner.

1.10 WARRANTY

- A. See requirements in Division 1 Specifications.

- B. The Security Integrator shall warrant all completed work, including all materials and labor, to be free from defects in design, workmanship, and/or materials for a period of two (2) years from final acceptance date.
 - 1. System acceptance is defined as the completion of all functional performance testing and the resolution of all punch list items.
- C. Warranty Service
 - 1. In the event that defects in the materials and/or workmanship are identified during the warranty period, the contractor shall provide all labor and materials to correct the deficiency.
 - 2. All service work shall be performed by factory certified technicians.
 - 3. All warranty service shall include the replacement of all parts and or components as required to restore normal system operation.
 - a) If parts or components need to be repaired, a loaner will be supplied and installed until the part or component can be repaired and reinstalled.
 - 4. Immediately following a warranty service request, the Contractor shall provide written documentation to Owner which details the service work completed, cause of trouble, and any outstanding work required to restore a complete and normal system.
- D. Warranty service requests shall be responded to within 4 hours of notification with a qualified service technician on site.
- E. All repairs shall be completed within 48 hours upon site arrival.
 - 1. If the failure exceeds 48 hours, the Owner reserves the right to require the contractor provide on-site manufacturer support at no additional cost to Owner.
- F. Extended warranties on equipment components offered by the manufacturer shall be passed through to the Owner.
 - 1. Warranty provisions shall be fully transferable only at the direction of the Owner, in the event that ownership of the installed security systems is transferred.

1.11 SYSTEMS STARTUP AND TRAINING

- A. After all systems have been tested, accepted and turned on for operation, the Security integrator shall provide "User Training" to Owner personnel.
 - 1. The onsite training shall cover all newly installed electronic security components, devices and systems. The training classes shall total a minimum of sixteen (16) hours for up to eight (8) people of the Owner's choosing.
 - 2. Two (2) separate training sessions will be conducted, one for system operators and one for system administrators.
 - 3. The contents of the manuals will include:

- a) Title page with subject, system name, owner's name, and an owner approved confidentiality notice.
 - b) Table of contents.
 - c) Manual that details system and sub-system operation.
 - d) Manuals that details system administration procedures and tasks.
 - e) Manuals that fully detail all programming commands.
4. Provide three (3) Bound hardcopy System Operation training manuals and one electronic copy (PDF format).
 5. Provide two (2) Bound hardcopy System Administration training manuals and one electronic copy (PDF format).

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturer's are shown in individual specification sections.
- B. Equipment manufacturers and model numbers indicated in individual specification sections are identified as minimum equipment requirements.
- C. All substitutions shall meet or exceed these minimum requirements and must be approved by the Owner/Architect prior to purchase.
- D. All manufacturers' equipment shall be available through a nationally recognized supplier network.

2.02 EQUIPMENT

- A. Provide security fasteners on all equipment, device plates, etc. within public areas.
 1. Allen head with center pin, hardened steel.
 2. Provide four (4) fastener tools to Owner.
- B. Equipment installed in exterior applications shall be fitted with fasteners and exposed surfaces of stainless steel or other corrosion resistant material.
- C. All materials and equipment used must be new and unused, prime quality products.
- D. All equipment or components installed on the exterior of a building where the equipment is subject to adverse weather/elements shall be enclosed in weatherproof enclosures.

2.03 WIRE AND CABLE

- A. All wire and cable shall be U.L. approved for its intended application and shall meet or exceed manufacturer's recommendations for the components connected.

- B. All conductors and cable shall meet individual security system manufacturer specifications.
 - 1. Provide shielded conductors and cable as required by the manufacturer or as required to provide for interference-free signals.
 - 2. Color coding shall be accomplished by using solidly colored insulation.
 - a) Grounding conductors, where insulated, shall be colored solid green or identified with green color as required by NEC.
- C. Increase conductor sizes on cables as required to be consistent with circuit current ratings, length of wire runs, and manufacturers' recommendations.
 - 1. Alarm device field wiring shall be in accordance with the equipment manufacturer's specifications.
 - 2. Low voltage power circuits shall use conductors as required by the equipment manufacturer's specifications.
 - 3. Plenum rated cable shall be used as required by code.
- D. UTP Structured Cabling Systems for IP cameras and intercoms (including pulling, terminating, and testing) by Division 27 Telecommunications contractor.
 - 1. Intra-building data communications circuits shall utilize UTP cable as specified in Telecommunications specifications.
- E. Patch Cables
 - 1. Provide pre-manufactured patch cables (cable, connectors, boots, etc.) as required to connect security systems to voice and data communication outlets.
 - 2. Patch cables shall be certified for their specific use to meet or exceed applicable industry specifications.
 - 3. Provide cable lengths as necessary to neatly route cables through cable management systems and other cable organization systems.
 - 4. Provide connectors as required for proper termination.
 - a) Provide boots for connectors where applicable to prevent snagging.
- F. The minimum conductor sizes are for distances as per the manufacturer's specifications from security device to security panel.
 - 1. The contractor shall size the conductor accordingly for longer runs.
 - 2. Minimum Conductor and Cable Types and Sizes.
 - a) Alarm device field wiring shall be 18/20 AWG stranded copper conductors.
 - b) Low voltage power circuits will use 18 AWG stranded copper conductors.
 - 1) Increase conductor gauge consistent with circuit current requirements.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All personnel working on this project shall be experienced, highly skilled installers with a minimum of three (3) years work on similar type projects.
- B. Changes in location of any work require the written approval of the Architect/Owner prior to initiation.
- C. Changes in indicated sizes shall not be made without the written approval of the Owner/Architect.
- D. Install all equipment in accordance with manufacturer's recommendations.
- E. All systems shall be designed and installed to provide 24 hour a day, 7 days a week operation.
- F. Primary pathways
 - 1. All security cabling run from rack/enclosure head-end equipment to security devices shall follow primary telecom routing pathways.
 - 2. Security wire non-UTP cabling shall be kept separated from the data cabling
 - 3. Security wire non-UTP cabling shall be routed in bridle rings secured to the outside of the telecom tray where applicable.
 - a) Arlington loops or J hooks shall be used where telecom pathways are not present
 - 4. Provide all necessary anchoring devices and supports.
 - a) Use structural supports suitable for equipment, or as indicated.
 - b) Check loading and dimensions of equipment with shop drawings.
 - c) Do not cut or weld to, building structural members.
- G. Secondary pathways
 - 1. Arlington loops or J hooks shall be used for secondary pathways
 - 2. Security wire non-UTP cabling shall be kept separated from the data cabling
 - 3. Provide all necessary anchoring devices and supports.
 - a) Use structural supports suitable for equipment, or as indicated.
 - b) Check loading and dimensions of equipment with shop drawings.
 - c) Do not cut or weld to, building structural members.
- H. Conduits (BY DIVISION 26)

1. All conduits shall be UL listed and comply with NEC requirements.
 2. Routing
 - a) Conduits shall be routed in the most direct route possible, with the fewest number of bends possible.
 - b) There shall be no continuous conduit sections longer than 100'-0" for premises conduits. For runs that total more than 100'-0", insert junction or pull boxes so that no continuous run between pull boxes is greater than 100'-0".
 3. Fill and Bend Radius
 - a) Conduit fill shall comply with NEC requirements.
 - b) There shall be no more than two 90° bends (180° total) between conduit pull boxes.
 - c) Unless otherwise noted in the drawings, conduits entering pull boxes shall be aligned with exiting conduits.
 4. Penetrations
 - a) All conduit penetrations shall comply with all applicable fire codes.
 - b) All conduit penetrations in fire-rated walls or floors shall be sealed and fire-proofed to meet or exceed the designed rating of the penetration area.
 5. Conduit Fittings
 - a) All fittings shall be compression or threaded.
 - b) Fittings shall provide a secure connection for pulling cables.
 - c) Setscrew fittings are not permitted.
 6. Measured Pull Tape
 - a) Pre-lubricated, woven polyester, low friction, and high abrasion resistant yarn with footage markers printed on the tape.
 - b) Minimum average tensile strength shall be 1130 lbs. for 0'-1.5" and smaller conduits and innerduct.
 - c) Minimum average tensile strength shall be 1800 lbs. for conduits larger than 0'-1.5".
- I. Junction Boxes and Back Boxes
1. Junction boxes and back boxes shall be UL listed and comply with NEC requirements.

2. Junction box and back box installations shall comply with all applicable fire codes.
 3. All junction box and back box installations in fire-rated walls or floors shall be sealed and fire-proofed to meet or exceed the designed rating of the wall the box is installed in.
- J. Coordinate extension and connection to commercial, emergency/UPS power circuits provided by Division 26.
1. Make power connections in accordance with Division 26.
- K. Shielded and/or screened cables shall be grounded per the hardware manufacturer's instruction.
1. Single point shield grounds shall be grounded at the field panel feeding the device or sub panel and insulated from ground at the termination end of the cable.
- L. All installation of security systems shall be complete at least thirty calendar days prior to occupancy.

3.02 RACK AND CABINET INSTALLATION

- A. Rack/cabinet installation by Telecommunications contractor.
- B. After racks are installed, install all required components to support rack mounted security equipment.
1. Extend UPS/emergency power to rack mounted equipment as required.
- C. Install all conduits, back boxes, wire and cable management as required for interconnection of security equipment, data gathering panels, power supply enclosures, and distribution panels in the Security room.
- D. Extend commercial/emergency/UPS power circuits as required to security components as required.
- E. Neatly lace and dress all cables in each rack.
1. All wiring and cable shall be properly supported.
 2. Utilize suitable cable management devices, no tie-wraps for UTP structured cabling allowed.

3.03 GROUNDING AND BONDING

- A. Equipment Cabinets and Racks
1. To provide electrical continuity between rack elements, paint-piercing grounding washers shall be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
 2. A horizontal busbar shall be installed at the top and back of each rack for floor fed cabinets/racks.

3. A vertical busbar shall be installed to the rear of the right-hand side rail with thread-forming screws to ensure metal-to-metal contact.
4. Each rack shall be provided with a minimum # 6 AWG insulated ground wire.
5. Do not bond racks serially (loop from rack to rack).
6. Each rack bay against a wall shall be bottom/side ground feeds from the wall.
 - a) Wall ground feeds/raceways to racks shall not be exposed on the walls.
 - b) Exception
 - 1) Some rack bays will require the ground to be fed from the ceiling raceway. Refer to drawings for details.
7. The Contractor shall provide a ground strap for each equipment rack and bond to the nearest Telecommunications Bonding Backbone (TBB) connection, Furnish all required bonding materials and hardware manufactured for this purpose.
 - a) Follow NEC bonding procedures/specifications.
8. All ground raceways within each rack shall be an insulated metallic flex type raceway and shall not interfere with equipment mounting frames or equipment mounting brackets.
9. Each ground feed shall provide proper installation allowances and penetration depths to provide conversion fittings from solid metallic to insulated metallic flex conduit raceways.
10. To bond each rack to ground, burnish clean a one square inch area, drill, tap, apply an adequate amount of antioxidant joint compound mixed for the metal surface types affected, and bolt connectorized conductor to burnished and compounded area.
 - a) Ensure proper conductivity.

B. Cable Runway, Cable Raceway and Support System Grounding

1. The Contractor shall provide communications cable tray and cable runway systems with a communications isolated ground from the TBB.
2. All cable tray needs to be electrically continuous per NEC 250.96.
 - a) Metal raceways, wire-mesh cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal non-current-carrying parts that are to serve as an alternate grounding path, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them.
 - b) Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces, and be connected by means of fittings designed so as to make good bonding points.
3. The Contractor shall provide and install #6 AWG insulated ground wire to bond one end of each cable tray/runway system to the #2/0 TBB.

4. For electrically non-continuous conduits that contain only grounding conductor, the Contractor shall bond the conduit and conductor together at both ends to ground to nearest TGB with grounding bushings or ground clamps.

3.04 LABELING

- A. Provide labeling for all security equipment components using waterproof, self-adhesive computer printed labels.
 1. Coordinate with Owner on numbering/labeling scheme.
- B. Provide labeling for all security cable/wiring using waterproof, self-adhesive computer printed labels.
 1. Coordinate with Owner on numbering/labeling scheme.
 2. Label all cables/wiring on both ends.
 3. At multi conductor cable terminations label each conductor.
 4. At a minimum, each cable/wire label shall designate:
 - a) Origination Point
 - b) Alarm point description
 - c) Opening description (if applicable)
- C. Provide a complete cable/wire identification plan/list with project completion submittal.
- D. Conduit and junction box exteriors may be identified with unique color paint, but shall not be identified with written words that easily identify the function of the conduit and boxes.

3.05 POWER REQUIREMENTS

- A. 120 VAC dedicated to security will be provided. (By Electrical Contractor)
- B. Back-up power for all equipment and devices shall be for at least 4 hours unless otherwise specified.
 1. When generator backup power is available, provide a UPS, rated to maintain the load for a minimum of 15 minutes for all 120VAC equipment.
- C. Rack-mounted Uninterruptible Power Supply (UPS)
 1. Provide a UPS to support 120% of the required load to allow for future load expansion and age related deterioration of the battery performance.
- D. All electronic locks shall be 12/24VDC (By Division 08)
- E. Connect to AC power and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.
 1. Provide uninterrupted battery backup power for the duration required above.

- F. All equipment connected to AC circuits shall be protected from power surges.
 - 1. The devices shall be installed and grounded per manufacturer instructions.
 - 2. Equipment protection shall meet requirements of ANSI C62.41.
 - 3. Fuses shall not be used for surge protection.
- G. All non-fiber optic data circuits that serve devices exterior to the buildings will be protected by surge protectors at the device and the termination.
 - 1. The devices shall be installed and grounded per manufacturer instructions.
 - 2. Equipment protection shall meet requirements of ANSI C62.41.
 - 3. Fuses shall not be used for surge protection.

3.06 TESTING

- A. Ensure that all provisions and requirements of this specification are met.
 - 1. Verify through inspections, demonstrations and tests.
- B. Perform required tests to demonstrate workmanship, operation, and performance.
 - 1. Conduct tests with Architect/Owner and if required, inspectors of agencies having jurisdiction present.
 - 2. Arrange test dates in advance and give all parties a minimum of 48 hours notice.
- C. Repair or replace equipment or systems found defective or inoperative and re-test until 100% satisfactory results are obtained.
- D. Verification inspections will be made of all equipment components and installations for proper functioning of locking hardware and lock controls, mounting/placement of sensors, and cameras, etc. to guarantee requirements of the Contract Documents are complied with.
 - 1. The Owner's quality control representative shall have the opportunity to witness all inspections, or to conduct installation inspections of his own.

3.07 FUNCTIONAL PERFORMANCE TEST

- A. The Functional Performance Test (FPT) will be conducted at the end of the project and prior to system acceptance by the Owner.
 - 1. The security integrator will provide all necessary staff and communications needed to fully test all functions of the system.
 - 2. The contractor will submit for approval by the Architect and Owner, a comprehensive test plan that will include testing of every function on every door and security device thirty (30) days prior to the scheduled start of the test.
 - 3. The system will not be considered for acceptance prior to the successful completion of the FPT and completion of punch list items.
- B. Pre-Testing

1. Following installation and prior to the FPT, the security integrator shall individually test each component and field device and verify the proper functioning of each component within a particular sub-system.
 - a) The contractor shall also test each sub-system until all detection zones, alarm assessment components, alarm reporting, surveillance and display components; along with access control functions have been verified.
 - b) Prior to the FPT all deficiencies must be corrected.
 - c) After sub-system verification is complete, test the entire system to assure that all elements and subsystems are compatible and function properly as a complete system.
- C. Upon completion of the outlined tasks and tests the security integrator shall schedule the FPT with the Architect and Owner.
 1. The security contractor must demonstrate that the security system components and sub-systems operate together as a system and meet specification requirements in the "As-Installed" operating environment.
 2. On conclusion of the FPT the test report document will be submitted to the architect for approval.
 3. The FPT will be observed by the architect's and Owner's representatives.
 4. The FPT may be stopped at any time by these representatives if they believe the failure rate is too high or the system is not performing to contract document requirements.
 5. The FPT will only resume when all deficiencies have been corrected.
 6. Retesting will be required of all failed tests.

3.08 SYSTEM OPERATIONAL TEST

- A. Upon completion of the FPT, conduct a formal test to be known as the System Operational Test (SOT), in which all components and sub-systems of the security system are demonstrated to operate error and failure free together as a system.
 1. This test is to be performed over a continuous seventy-two (72) hour period.
 2. A formal test plan and test procedures shall be prepared by the security subcontractor and submitted to the Owner/Architect for approval.
 3. The Security integrator must demonstrate that the system components and sub-systems meet specification requirements in the "As-Installed" operating environment and operate error and failure free for the duration of the test.
 4. If a system failure does occur, the failure must be documented and repaired, after which the seventy-two hour SOT period will restart.
- B. In the event that the Owner, Architect, or Contractor are required to witness a retest at a later date because the Security integrator is not properly prepared to conduct the acceptance tests or because the systems being tested have failed such tests, which shall be solely determined by the Architect or Owner witnessing the tests, the cost of witnessing additional tests shall be borne exclusively by the Security integrator.
 1. Costs are to be based on time and materials at the established rates of the Architect or Owner.

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END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- A. See Specification 01 9113 General Commissioning Requirements.

END OF SECTION

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SECTION 28 10 00 – ACCESS CONTROL AND INTRUSION DETECTION

PART 1 GENERAL

1.01 SUMMARY/OVERVIEW

- A. This section provides specifications for the installation of Electronic Access Control (AC), Intrusion Detection (ID), and related components.
- B. Related Sections
 - 1. Section 087100 Door hardware
 - 2. Section 260000 Electrical (including related sub-sections)
 - 3. Section 270000 Communications (including related sub-sections)
 - 4. Section 280000 Electronic Security
 - 5. Section 282300 Video Surveillance
 - 6. Section 283100 Fire Alarm and Smoke Detection

1.02 REFERENCES

- A. See Section 280000 Electronic Security.

1.03 SYSTEM COORDINATION

- A. The Security Integrator shall completely coordinate all relevant work of other trades/systems including, but not limited to:
 - 1. Door hardware
 - 2. Fire Alarm System
 - 3. Electrical Systems(s)
 - 4. Telecommunications System(s)
- B. Electric Locking Mechanisms
 - 1. The security integrator and door hardware contractor shall coordinate all door hardware, door and door frame design.
 - 2. The security contractor shall verify all specified door hardware is appropriate for the security application and verify the sequence of operations for each access controlled opening.
- C. Fire Alarm and Life Safety
 - 1. The security integrator shall coordinate the access control system design with the life safety consultant to ensure compliance with applicable codes and requirements.
 - 2. This includes, but is not limited to:
 - a) Fire alarm interface
 - b) Fail safe/fail secure locking mechanisms

c) Delayed egress

1.04 GENERAL SYSTEM DESCRIPTION

A. General Requirements

1. Furnish all labor, materials, tools, equipment, and services for a complete security system as indicated and in accordance with provisions of the contract documents.
2. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.
3. Comply with the provisions of Division 1 for General Requirements.

- a) In the event of a conflict between the provisions of this Section and Division 1, the more stringent provisions shall apply.

4. All system devices and components included shall be compatible.

B. Provide an AC/ID system to support project requirements as specified herein.

1. The AC/ID system will support the completed facility.
2. The AC/ID system will be expandable to accommodate cardholder enrollment of all city employees, and control and monitoring of all city facilities.

C. Provide AC/ID workstations as indicated on the drawings.

1. The AC/ID system will be connected via the Owner's Local Area Network (LAN) for control and monitoring.
2. Coordinate AC/ID programming with the Owner to ensure that all systems and alarm points report at appropriate monitoring locations.
3. Refer to Section 282300 for additional requirements.

D. The AC/ID system shall be interfaced with the Fire Alarm system (by others) as required to comply with all building code requirements.

E. Dedicated 120VAC power will be provided by electrical contractor to power:

1. AC/ID Data Gathering Panels (DGPs)
2. AC/ID rack mounted equipment

1.05 ACCESS CONTROL SYSTEM

A. The AC system will consist of host computer, computer workstations, software, card readers, , access cards, Data Gathering Panels (DGPs), door position sensors, and request-to-exit sensors operating in conjunction with associated electric door hardware.

1. AC Host Computer

- a) Provide AC host computer hardware and software in accordance with manufacturer specifications for a system with the following capacity:

- 1) AC Workstations: 5 concurrent
 - 2) Card readers: 50
 - 3) Alarm points: 1,000
 - 4) Control points: 1,000
 - 5) Cardholders: 1,000
- b) The AC system will communicate via the Owner's Local Area Network (LAN).
 - c) The security subcontractor is responsible to coordinate setup and programming to ensure that all systems and alarm points report correctly at the remote location.
 - d) AC software must be compatible with DGPs specified herein. Provide operating system, software and database in accordance with AC manufacturer specifications.
2. Card readers and adjunct devices shall be provided as shown on the drawings.
 - a) Provide card readers, Data Gathering Panels <DGP>, and alarm input and output devices connected to the security management system via Local Area Network (LAN).
 - b) The security integrator shall coordinate network and IP address requirements with Owner to identify the Media Access Control (MAC) address (Layer 2) of each provided device, the location to be installed, and the port configuration needed for communication.
 - c) Furnish all labor, materials, tools, equipment, and services for a complete system as indicated and in accordance with provisions of the contract documents.
 - d) Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, and devices incidental to or necessary for a sound, secure and complete installation.
- B. Data Gathering Panel (DGP)
1. Controller
 - a) Power: 12-24 VDC
 - b) Communications: Primary 10/100 Ethernet; Secondary RS-232, RS-485, modem
 - c) Alarm inputs: Cabinet tamper and power monitor
 - d) Battery backup: Onboard memory and clock
 - e) Standards: UL294 recognized, CE compliant, ROHS

f) Access Control: 600,000 cardholder capacity, 50,000 transaction buffer

2. Card Reader Interface

a) Power: 12-24 VDC

b) Outputs: 6 form-C

c) Inputs: 8 unsupervised/supervised; 2 unsupervised cabinet tamper and UPS fault.

d) Card reader capacity: Two

e) Card reader interface: 12VDC reader power

f) Card reader port compatibility: Wiegand data 1/data 0; magnetic clock/data; F/2F single wire; Open Supervised Device Protocol

3. Alarm Input Interface

a) Power: 12-24 VDC

b) Outputs: 2 form-C, 5A

c) Inputs: 16 unsupervised/supervised; 2 unsupervised cabinet tamper and UPS fault

d) Communications: RS-485

4. Output Control Interface

a) Power: 12-24 VDC

b) Outputs: 16 form-C, 5A

c) Inputs: 2 unsupervised cabinet tamper and UPS fault.

d) Communications: RS-485

C. Access Card:

1. Technology: 125 kHz proximity and 13.56 MHz contactless smart card.

2. Size: CR-80

3. Quantity: 100

D. Card readers will work such that upon presentation of a valid AC card, the unique card data
Card readers will work such that upon presentation of a valid AC card, the unique card data

1. A valid authorization will activate operation of the electric lock and shunt the door position switch. The alarm shunt will not affect supervision of the detection circuit.

2. Coordinate with owner on card format and other pertinent details.

- E. Card readers shall support both 125 KHz proximity and 13.56 MHz smart card technologies
- F. Door position switches at card reader controlled location serve to indicate the open/closed status of the associated door and shall establish the basis for reporting a door-propped or unauthorized entry condition.
 - 1. Provide door position switches as indicated on drawings.
 - 2. Security contractor is responsible for coordinating the contact configuration (SPDT) (DPDT) and rating for door position switches, and for connection of switches with the AC.
- G. Electrified door hardware for card reader controlled doors will include electrified locksets, electric exit devices, and electric power transfer as shown on the drawings.
 - 1. All electrified door hardware shall be provided under the work of Division 08 unless otherwise noted.
 - 2. Security subcontractor shall provide security cables/conductors and low voltage power supplies for security system controlled electric door hardware.
- H. Request-to-exit (REX) devices at designated card reader controlled doors shall cause the associated door position switches to be shunted.
 - 1. The alarm shunt shall not affect the supervision of the alarm detection circuit.
 - 2. Electrified Lockset shall have an integral REX switch
 - 3. Electrified Exit devices shall have an integral REX switch

1)

1.06 INTRUSION DETECTION SYSTEM

- A. A series of field installed alarm initiating devices shall be connected to the ID system so that status changes of the devices are transmitted to the security management system.
 - 1. Provide Alarm Panels <AP>, alarm devices, and keypads to be connected to the security management system via Local Area Network (LAN).
 - 2. The security integrator shall coordinate network and IP address requirements with Owner to identify the Media Access Control (MAC) address (Layer 2) of each provided device, the location to be installed, and the port configuration needed for communication.
- B. Motion Detector
 - 1. Provide dual technology (microwave and infrared) to prevent false alarms.
 - a) Specific model depends on application and mounting requirements.
 - b) One motion detector per zone, do not wire in series.
- C. Glass Break Detector

1. Contractor will need to provide compatible glass break tester for device being installed.
2. One glass break detector per zone, do not wire in series.

D. Tamper Switches

1. Typically closed tamper switches to monitor the secure status of all DGP's, power supplies, terminal cabinets, power distribution units, and other Security System cabinets and enclosures.
2. Fasten tamper switches within the cabinet to provide no access to the switch and fasteners when the cabinet is closed.
3. Provide independent monitoring of tamper conditions for each cabinet.
 - a) Include the number of tamper switches in the total alarm input figures.

- E. Provide ID keypads conveniently located near areas being protected so as to allow devices to arm and disarm.

1.07 SUBMITTALS

- A. Follow provisions of Section 280000 additional requirements.

B. Field Test Reports

1. Upon completion and testing of the installed system, test reports shall be submitted in booklet form and electronic media showing all field tests performed on, and adjustments made to each/any component and all field tests performed to prove compliance with the specified performance criteria.
2. Indicate and interpret test results in written form and verbally to owner/DataCom for compliance with performance requirements at a pre-scheduled meeting.

- C. Battery calculations to show the expected loads and backup duration for power supplies and UPS devices for all active AC/ID equipment.

- D. Security Contractor is responsible to prepare and submit as required to the Authority Having Jurisdiction (AHJ) any and all information to obtain an Electronic Locking Mechanisms permit.

1.08 QUALITY ASSURANCE

- A. Follow provisions of Section 280000.

B. Spare Parts:

- a) The security integrator will turn over the new and unused components and devices to the owner at project closeout.

1.09 DELIVERY, STORAGE AND HANDLING

- A. Follow provisions of Section 280000.

1.10 PROJECT/SITE CONDITIONS

- A. Follow provisions of Section 280000.

1.11 WARRANTY

- A. Follow provisions of Section 280000.
- B. All devices and components shall comply with applicable U.L. standards.

PART 2 PRODUCTS

2.01 ACCEPTABLE SYSTEM MANUFACTURERS

- A. AC System Platform Software
 - 1. Genetec Synergis
 - 2. Lenel OnGuard
 - 3. Open Options DNA Fusion
 - 4. S2 Security
- B. System Platform Server)
 - 1. Dell
 - 2. Hewlett Packard
 - 3. IBM
 - 4. Owner Approved Equivalent
- C. Workstation (refer to 282300)

2.02 ACCEPTABLE ACCESS CONTROL MANUFACTURERS

- A. Access Control Data Gathering Panels <DGP>
 - 1. AC/ID System compatible
 - 2. Owner Approved Equivalent
- B. Proximity Card Readers <CR>
 - 1. HID RP40
 - 2.
 - 3. Owner Approved Equivalent
- C. Door Position Switches <DP>
 - 1. Concealed Magnetic Door Position Switch
 - a) George Risk Industries (GRI) 199-12
 - b) Sentrol 1076D

- c) Owner Approved Equivalent
- D. Electric Locking Mechanism Power Supply
 - 1. Altronix
 - 2. Alarm-Saf
 - 3. LifeSafety Power
 - 4. Owner Approved Equivalent
- E. Electric Locking Mechanisms (By Division 08)
 - 1. Sargent
 - 2. Schlage
 - 3. Von Duprin
 - 4. Locknetics
 - 5. Owner Approved Equivalent
- F. Electric Power Transfer (By Division 08)
 - 1. Security Door Controls (SDC)
 - 2. Schlage
 - 3. Von Duprin
 - 4. Owner Approved Equivalent
- G. Uninterruptible Power Supply <UPS>
 - 1. Eaton UPS
 - a) 5S series for workstations
 - b) 9170 for rack mounted equipment
 - 2. APC Smart-UPS Series
 - a) SMT series for workstations
 - b) Smart-UPS on-Line series for rack mounted equipment
 - 3. MinuteMan
 - a) Pro series for workstations
 - b) Enterprise Plus series for rack mounted equipment
 - 4. Owner Approved Equivalent
- H. Wire & Cable
 - 1. Belden
 - 2. Windy City
 - 3. General Cable

4. Owner Approved Equivalent

2.03 ACCEPTABLE INTRUSION DETECTION MANUFACTURERS

A. ID System Platform

1. Bosch
2. DMP
3. Honeywell
4. Tyco
5. Owner Approved Equivalent

B. Intrusion Detection Alarm Panels <AP>

1. AC/ID System compatible
2. Owner Approved Equivalent

C. Keypads

1. AC/ID System compatible
2. Owner Approved Equivalent

D. Tamper Switches

1. Sentrol 3010
2. Owner Approved Equivalent

E. Dual Technology Motion Detectors

1. AC/ID System compatible
2. Owner Approved Equivalent

F. Glass Break Detectors

1. AC/ID System compatible
2. Owner Approved Equivalent

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Power Supplies

1. Power supply requirements
 - a) A switch and on/off indicator within the power supply cabinet.
 - b) Four hours of sealed gel battery backup to provide continuous operation during power failure.

- 1) Provide batteries as required to provide specified battery backup time for a fully loaded power supply, regardless of the connected load.
 - c) A battery charger to maintain the battery.
 - d) Low battery and power fail contacts to monitor the status of the input power and the battery.
 - 1) Connect each power supply low battery and power fail alarm as a separate alarm input into DGP.
 - e) Key lockable wall mount metal enclosure with tamper switch.
 2. Additional DGP Power Supply Requirements
 - a) The DGP power supply provides power only to DGP's and shall not provide power for locks or any other low voltage device.
 3. Additional Electric Locking Mechanism Power Supply Requirements
 - a) Fail secure electric locking mechanisms shall remain locked during power failure and fire alarm conditions.
 - b) Connect fail safe locking devices in accordance with applicable life safety codes to unlock automatically under the following conditions:
 - 1) Loss of power to the power supply
 - 2) Failure of the power supply
 - 3) Fire alarm activation
 - c) Provide power distribution boards with independently fused output relays and fire alarm control panel interface.
 4. Additional Device Power Supply Requirements
 - a) Provide device power supplies for other security system devices requiring power (e.g. card readers, local alarms, motion sensors, etc.)
 - b) Provide power distribution boards with independently fused outputs.
- B. Tamper Resistant Screws
 1. Provide appropriate screw heads for each application (e.g. countersunk heads for recessed cover plate screws, flat head screws for standard junction box covers, etc.).
 2. The security integrator shall provide Torx® tamper resistant screws for:
 - a) Junction boxes located above doors
 - b) Junction boxes located below ceiling height and/or within reach of hatch ladders

- c) Security device cover plates
- d) Surface mounted door position switches and armored cable

3.02 ENCLOSURE INSTALLATION

- A. Enclosures shall be lockable with a tamper switch and installed in a manner to be accessible with clearance to fully open enclosure door.
- B. All security panels shall be wired through a dedicated power supply with battery backup.
 - 1. Power to the data gathering panels is to be hardwired utilizing EMT or rigid conduit in accordance with the Electrical specifications.
 - 2. A circuit from the Fire Alarm panel must be installed to each lock power distribution panel.
- C. Enclosures shall be installed on designated wall fields in a neat and compact manner to allow for future growth.
- D. Enclosures shall be sized to allow for 20% growth in each panel.
- E. All panels and boards shall be installed in enclosure(s) suitable to their environment and have sufficient size and orientation to include all system components.
- F. Each panel shall be labeled accordance with Owner standards.

The label for each panel shall be posted on the exterior of the panel door.

- a) Each panel shall have a list of devices connected to it located on the inside cover.
- b) A detailed device layout drawing will be located on the inside of the panel door in an appropriate sleeve and keeper.

3.03 FURTHER REQUIREMENTS

- A. Refer to provisions of Section 280000.
- B. Furnish and coordinate installation of all special device back boxes and ACID field devices as shown on the security drawings and as specified in this section.
- C. The exact installation locations of all equipment shall be coordinated and verified with the Contractor prior to installation.
 - 1. Subcontractor shall notify the Contractor if any location appears to be unsuitable.
- D. Provide low voltage power supplies for electric locking devices and ACID devices and components as shown on the security drawings and specified in this Section.
- E. Coordinate with the Telecommunications Subcontractor for data network connections, IP address requirements, and telephone circuits as required.

- F. Prepare all systems for user operation.
 - 1. The security system must be complete and ready to operate prior to Owner final acceptance of the system.
- G. Coordinate with the Owner for all system programming requirements.
- H. Perform database programming as required to support the card reader, alarm point, surveillance system integration, and control panel configuration as required.

END OF SECTION

SECTION 28 23 00 – VIDEO SURVEILLANCE

PART 1 GENERAL

1.01 SUMMARY/OVERVIEW

- A. This section provides specifications for the installation of an IP based Video Surveillance System (VS) and related components.
- B. Related Sections
 - 1. Section 260000 Electrical (including related sub-sections)
 - 2. Section 270000 Communications (including related sub-sections)
 - 3. Section 280000 Electronic Security
 - 4. Section 281000 Electronic Access Control and Intrusion Detection

1.02 REFERENCES

- A. See Section 280000 Electronic Security.

1.03 SYSTEM DESCRIPTION

- A. Provide a Video Surveillance (VS) system to support project requirements as specified herein. The VS will consist of Network Video Recorders (NVRs), computer workstations, software and software licenses, surveillance cameras, Uninterruptible Power Supply (UPS), , Monitor and Mount, wiring & cabling, and low voltage camera power supplies.
 - 1. The VS system will support the completed facility.
 - 2. The VS system will be expandable to accommodate surveillance of all city facilities.
 - 3. The VS system will be connected via the Owner's Local Area Network (LAN) for camera control and monitoring.
 - 4. Coordinate VS programming with the Owner to ensure that all cameras are viewable at appropriate monitoring locations.
 - 5. The VS system shall provide for recording, local monitoring, and remote monitoring of cameras.
 - 6. VS system surveillance and communication equipment shall be on emergency/UPS power.
- B. Network Video Recorder and Software
 - 1. Provide NVR hardware and software in accordance with manufacturer specifications for a system with the following capacity:
 - a) Workstations: 5 concurrent
 - b) Cameras: 25
 - 2. The VS system will communicate via the Owner's Local Area Network (LAN).
 - 3. The security subcontractor is responsible to coordinate setup and programming to ensure that all cameras are displayed correctly at each workstation.

4. VS software must be compatible with cameras specified herein. Provide operating system, software and database in accordance with VS manufacturer specifications.
5. Provide VS software that may be expanded via software license upgrade. VS software expansion must not require replacement of host computer operating system and database.
6. Provide VS software with the following features
 - a) Simultaneous video record, playback, live view and video export
 - b) Thick client, web client, mobile client for Apple iOS and Android OS
 - c) Video event search capability based upon:
 - 1) External alarm input
 - 2) Video motion
 - d) Independent camera recording frame rate control
 - e) Multiple monitor support
- C. Camera assemblies include camera, lens, housing, and mount. Provide and install wiring and low voltage power from the security wall field/rack to the camera locations.
 1. Scope of work shall be complete from point of origin (camera) to point of termination (security rack).
- D. Provide rack mount 1U monitor/keyboard/track ball drawer with 20" LCD monitor for display and programming, keyboard, track ball, and integrated four-port KVM switch.
 1. Provide additional KVM ports as required plus two spare ports if Work includes more than two NVRs.
- E. Coordinate all work that must be performed in security head end spaces with the General Contractor, the Electrical Contractor, and the Telecommunications contractor. (if applicable)
- F. Camera images shall support H.264 compression formats.
- G. Provide NVR with 50% spare storage capacity for future expansion.
- H. Camera lenses for fixed cameras shall be varifocal and sized to provide the owner approved field of view. The lens shall be IR corrected and have megapixel resolution.
- I. Surveillance camera audio functions shall not be installed and/or disabled unless specifically requested by Owner.

1.04 SUBMITTALS

- A. Follow provisions of Section 280000 for additional requirements.

- B. Project Data
 - 1. Provide a description of system operation indicating the purpose and capability of each device/component of the system with a functional diagram indicating all interfaces to other systems.
- C. Video Quality test reports shall be provided for all cameras to confirm an optimum high definition video signal.
- D. Shop drawings shall reflect all requirements associated with Owner provided or existing equipment and materials that will be used as part of this system.
- E. Video Storage calculations to show the system capacity can accommodate the specified video retention.
- F. Battery calculations to show the expected loads and backup duration for camera power supplies and UPS devices for all active surveillance equipment.
- G. System programming, camera titles, descriptions, camera images and database
 - 1. Camera titles and descriptions prior to system programming
 - 2. Programming/database prior to performance testing
 - 3. Provide a cross reference between specified camera numbers and programmed camera numbers
 - 4. Final programming, camera images and system documentation on electronic media to Owner
- H. Product Data
 - 1. Manufacturer's technical data sheets and specifications

1.05 QUALITY ASSURANCE

- A. Follow provisions of Section 280000.
- B. Spare Parts:
 - 1. Turn over unused components to the owner at project closeout.

1.06 DELIVERY, STORAGE AND HANDLING

- A. See Section 280000.

1.07 PROJECT/SITE CONDITIONS

- A. See Section 280000.

1.08 WARRANTY

- A. See Section 280000.

PART 2 PRODUCTS

2.01 CAMERA SPECIFICATIONS

- A. All cameras shall be a Dome Camera unless otherwise specified
1. Compatible with the VMS
 2. Vandal resistant with polycarbonate dome
 3. Wide Dynamic Range Feature: All exterior cameras and interior cameras that have exterior lighting or headlights in their field of view shall have a Wide Dynamic Range feature to improve picture quality in situations with strong backlighting.
 4. Multi-stream so that recording and viewing can be at different frame rate and compression.
 5. Day-night Color/B&W camera with cut filter
 6. Exterior cameras:
 - a) Shall be outdoor rated
 - b) Include a heater to permit fog-free viewing in low temperatures
 - c) Fan to prevent overheating in high temperatures (as required)
- B. Interior Fixed Dome Cameras:
1. Shall be IP, PoE IEEE 802.3af
 2. Day-night Color/B&W camera with cut filter
 3. Smoked lower dome
 - 4.
 5. Vari-focal auto-iris fixed lens sized to provide the owner approved field of view
 6. Shall have a minimum sensitivity of 0.05 Lux at:
 - a) 30 IRE
 - b) 75% reflectance
 - c) AGC off
 - d) 1.2 f-stop
 - e) Sense-Up off
 - f)
- C. Exterior Fixed Dome Cameras:
1. Shall be IP, PoE IEEE 802.3af
 2. Clear lower dome, unless otherwise specified
 3. Resolution shall be a minimum of 2MP (1080p) at 30 FPS
 4. Vari-focal auto-iris fixed lens sized to provide the owner approved field of view.
 5. Shall include remote focus and zoom over the network
 6. Shall have a minimum sensitivity of 0.05 Lux at:

- a) 30 IRE
 - b) 75% reflectance
 - c) AGC off
 - d) 1.2 f-stop
 - e) Sense-Up off
- D. Exterior Multi Sensor 180°, 270°, and 360° Camera:
- 1. Resolution shall be a minimum of 8MP at 30 FPS (4x 1080p)
 - 2. Shall be IP, PoE IEEE 802.3af
 - 3. Clear lower dome, unless otherwise specified
 - 4. Allows for up to 4 multiple views
 - 5. Varifocal auto-iris fixed lens sized to provide the owner approved field of view.
 - 6. Outdoor rated to meet IP66
 - 7. Shall have a minimum sensitivity of 0.17 Lux at 50 IRE

2.02 NETWORK VIDEO RECORDER

- A. The Network Video Recorder shall be compatible with the video management system along with the following minimal requirements:
- 1. Hot swappable storage drives in a RAID 5 array
 - 2. Dual hot swappable redundant power supplies
 - 3. Support dual stream cameras
 - 4. Include a dual Network Interface Card (NIC) that supports:
 - a) Full duplex
 - b) Fault tolerance
 - c) Link aggregation
 - d) Load Balancing
 - e) Traffic prioritization
 - f) Hot swap
 - 5. Native support of H.264 compression that does not require the use of additional software or equipment
 - 6. Provide a 20 inch 1080P service monitor and keyboard at each NVR equipment rack
 - 7. Provide video storage capacity for 30 days using the following minimum criteria
 - a) All cameras using H.264 compression
 - b) Interior cameras: Use native camera resolution

- c) Exterior cameras: Use native camera resolution
 - d) Wide angle lens cameras: Use native camera resolution
 - e) Motion triggered recording
 - 1) Assume that motion will be detected 50% of the day
 - 2) Motion detection will be configurable by camera and schedule to mitigate nuisance triggers
 - 3) Record video at 12 FPS when motion is detected
 - 4) Record video at 1 FPS when no motion is detected
- B. Coordinate with owner on the number of user licenses required
- C. Provide UPS for backup power to the NVR and peripheral equipment
- 1. Follow provisions of Section 28000 for UPS power requirements
 - 2. Coordinate with Division 26 to provide a dedicated Emergency Power circuit

2.03 WORKSTATION

- A. Provide a fully configured high-speed workstation that will deliver acceptable performance with adequate hardware, processing capacity and peripherals to support the VMS, Access Control, Intrusion Detection systems and the owner provided business suite applications.
- 1. Coordinate with Section 281000 contractor for AC and ID requirements
 - 2. Provide all required VMS application and required VMS administration software
 - 3. Coordinate with owner's IT department
 - a) Workstation IP address
 - b) Operating system
 - c) Configuration
 - d) Security requirements
 - e) Business application software requirements
- B. Provide two (1) high definition 30" monitors
- 1. Resolution: 1920x1080 with progressive scan
 - 2. Widescreen 16:9 aspect ratio
 - 3. .

2.04 ACCEPTABLE MANUFACTURERS

- A. Video Management System (VMS) Platform Software
- 1. ExacqVision VMS
 - 2. Genetec Omnicast

3. Milestone Systems
 4. OnSSI Ocularis
 5. Salient Systems
 6. Owner Approved Equivalent
- B. NVR Server: Compatible with VMS Requirements
1. NVR specification compliant hardware
- C. Workstation Hardware:
1. Dell
 2. HP
 3. Owner Approved Equivalent
- D. Video Monitor:
1. Viewsonic
 2. Samsung
 3. Optquest
 4. LG
 5. Owner Approved Equivalent
- E. Interior IP Camera Mini Dome
1. Axis Communications
 2. Bosch
 3. Sony
 4. Owner Approved Equivalent
- F. Exterior IP Camera Mini Dome
1. Axis Communications
 2. Bosch
 - 3.
 4. Sony
 5. Owner Approved Equivalent
- G. Equipment Racks and Racks Components: (By Division 27)
1. Chatsworth Products (CPI)
 2. Ortronics
 3. Newton Instruments
 4. Owner Approved Equivalent
- H. Lockable Equipment Cabinet and Components: (By Division 27)
1. Chatsworth Products (CPI)
 2. Ortronics
 3. Newton Instruments
 4. Owner Approved Equivalent

- I. PoE Network Switch – Owner Provided / Coordinate with Owner
- J. Video Wire & Cable
 - 1. Windy City
 - 2. General Cable
 - 3. Belden
 - 4. CommScope
 - 5. Owner Approved Equivalent
- K. Uninterruptible Power Supply (UPS)
 - 1. Eaton UPS
 - a) 5S series for workstations
 - b) 9170 for rack mounted equipment
 - 2. APC Smart-UPS Series
 - a) SMT series for workstations
 - b) Smart-UPS on-Line series for rack mounted equipment
 - 3. MinuteMan
 - a) Pro series for workstations
 - b) Enterprise Plus series for rack mounted equipment
 - 4. Owner Approved Equivalent

PART 3 EXECUTION

3.01 CONFIGURATION

- A. IP PoE Cameras
 - 1. The security integrator shall coordinate network and IP address requirements with Owner to identify the Media Access Control (MAC) address (Layer 2) of each provided camera, the location to be installed, and the port configuration needed for communication.
 - 2. Make all necessary adjustments to camera lenses to obtain clear, crisp images and desired field of view to the Owners satisfaction.
 - a) Substitute camera lenses as necessary to obtain required field of view at no additional cost.
 - 1) Adjust all cameras to produce high-definition images with no blooming, streaking or noticeable lag.

- 2) Provide and install in-line PoE injectors as required when non PoE network switches are used or when manufacturer specified power is not available to the camera.
- 3) All camera power shall comply with the specified power requirements.

3.02 POWER REQUIREMENTS

- A. Provide uninterruptible power supplies for all active surveillance equipment
 1. Rack mounted components, including all active network communication hardware, shall be on an Uninterruptible Power Supply <UPS> system.
 2. Refer to Section 280000 for UPS and power requirements
 3. Camera power supplies shall be on an Auxiliary Power Supply <APS>, system as required, with a battery backup.
 - a) The Auxiliary power supply shall be furnished with a power distribution panel with each camera individually fused or protected with an over-current protector.
- B. Power supplies shall provide:
 1. 120 VAC input and output voltage as required
 2. UL Listed
 3. Power fail contacts to monitor the status of the input power
 - a) Connect each power supply power fail alarm as a separate alarm input into AC/ID system
 4. Key lockable wall mount metal enclosure with tamper switch
 5. Independently fused outputs

3.03 INSTALLATION

- A. Refer to provisions of Section 280000
- B. All surveillance system devices and components shall be compatible.
- C. Review landscape drawings, Building Information Model (BIM) files, and field verify landscape and adjacent architectural structures to ensure that video surveillance camera views are on target and unobstructed.
- D. Camera Housings and Mounts
 1. Cameras shall include housings and mounts as indicated in the Drawings.
 - a) Provide the smallest available housing for each camera application.
 - 1) Integrated miniature dome cameras are preferred

2. Wiring to cameras shall pass from the back-box through the mount and into the housing. Exposed wiring or conduit shall not be acceptable.
 3. Provide sun shields for camera housings in outdoor locations exposed directly to sunlight.
 4. Provide surge protection for power and copper video cables for exterior cameras at the camera and at the point of termination (security rack).
 5. Field verify the exact camera location, position, and mounting prior to installation.
 6. Roof mounted cameras shall use roof deck brackets.
- E. Video Management Control System
1. The system shall allow for secure remote viewing of live and recorded video as required.
- F. Provide labeling suitable to Owner for all major equipment components. Coordinate with Owner on numbering scheme to match existing. Major equipment components:
1. Video monitors, IP camera Patch Panels, PoE Switches (or mid-span units), Network Video Recorders (NVR), and fiber mux units (if required).
- G. Coordinate with Telecommunication subcontractor for network and patch panel provisions for security connections in the IT room. (If applicable)
- H. Coordinate with Owner for all system programming and database requirements.
1. Provide all programming, setup, camera and device titling and data entry
 2. Camera and device title and descriptions shall be consistent for all components
- I. Install all Point-to-Point wiring with appropriate terminal connections for every wire and component termination so that all connections are mechanically and electrically secure.
- J. Install field wiring in continuous lengths, without splices.
- K. Verify upon job completion that all wiring and terminations are clearly labeled to identify the wire and terminal.
- L. Testing of the surveillance system includes checkout of installed cameras back to the Security head end equipment to confirm proper operation of camera assemblies. Security integrator shall provide all necessary test equipment to fully demonstrate proper performance of field devices. Copies of test results shall be included in the project completion submittals given to the Owner.

END OF SECTION

SECTION 28 31 00 - FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Final planning and design of an NFPA 72 compliant microprocessor-based addressable fire alarm and detection system. The installing contractor shall be responsible for providing the final planning and design of the system in accordance with the Texas Board of Engineers Policy Advisory Opinion titled "Planning of Fire Alarm Systems" approved on April 22, 2004. The contractor shall fully familiarize himself with that document and comply with its requirements in every respect. The information given on the contract documents is intended to fulfill the minimum information requirements of the policy advisory, including the applicable prescriptive codes and standards and the specific building use and/or occupancy classification. The Contract Documents, in addition to the meeting the minimum requirements of the policy advisory, include additional requirements regarding the function, performance and operation of the devices and system to be used in planning system. Any device placement locations and quantities depicted on the plans are intended to be used only for initial guidance in the contractor's final planning and design. The contractor shall provide additional devices and revise locations as required to provide a design and installation fully complying with both applicable codes and additional contract requirements.
- B. Furnishing, installing and testing of the system to provide a complete and working system.

1.02 REFERENCES

- A. Referenced Publications:
1. NFPA 1, Uniform Fire Code
 2. NFPA 13, Standard for the Installation of Sprinkler Systems
 3. NFPA 14, Standard for the Installation of Standpipe and Hose Systems
 4. NFPA 70, National Electrical Code
 5. NFPA 72, National Fire Alarm Code
 6. NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems
 7. NFPA 101, Life Safety Code
 8. IBC – International Building Code
 9. IFC – International Fire Code
 10. UL Standard 268, Smoke Detectors for Fire Protective Signaling Systems
 11. UL Standard 268A, Smoke Detectors for Duct Application
 12. UL Standard 346, Waterflow Indicators for Fire Protective Signaling Systems

13. UL Standard 521, Heat Detectors for Fire Protective Signaling Systems
14. UL Standard 864, Control Units for Fire Protective Signaling Systems
15. UL Standard 1424, Cables for Power-Limited Fire Protective Signaling Systems
16. UL Standard 1480, Speakers for Fire Protective Signaling Systems
17. UL Standard 1481, Power Supplies for Fire Protective Signaling Systems
18. UL Standard 1711, Amplifiers for Fire Protective Signaling Systems
19. UL Standard 1971, Signaling Devices for the Hearing Impaired
20. TAS-Texas Accessibility Standards
21. American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI):
 - a. ANSI A17.1, Elevator Code, latest edition.
 - b. ANSI A17.3, Elevator Code for Existing Elevators, latest edition.

1.03 SYSTEM DESCRIPTION

- A. Provide a complete and working digital, addressable, closed-circuit, automatic and manual fire detection/alarm system to perform detection, monitoring, and alarm functions for the building.
- B. All system product lines must be comprised of components capable of providing the following features when specifically required in the project documents:
 1. Floor above/floor below notification.
 2. Private alarm notification.
 3. Positive alarm sequence.
 4. Voice alarm notification.
 5. Elevator capture/recall.
 6. Elevator power shunt trip.
 7. Smoke control/fan shutdown.
 8. Door hold-open release.
 9. Release locks on normally locked egress doors.
 10. Release of clean agent and/or pre-action sprinkler systems.
 11. Monitoring of fire suppression systems.
 12. Multiple channel voice

- C. Provide audible alarming throughout the building in accordance with NFPA 72.
- D. Provide visual alarming to TAS requirements throughout the building.
- E. The equipment furnished shall be listed and approved by a testing laboratory that has been approved by the State of Texas Commission on Fire Safety. This listing shall be for all functions required by this specification.
- F. All systems must comply with applicable paragraphs of the National Electric Code.

1.04 SUBMITTALS

Prior to installation, the following documents shall be provided to Owner for reference and/or approval:

- A. Shop Drawings: Include manufacturer's name, model numbers, ratings, power requirements, equipment layout, conduit, device arrangement, and complete point to point wiring diagrams along with other required information including but not limited to:
 - 1. General Drawing Notes
 - 2. Electrical back box requirements
 - 3. Control Equipment Schedules
 - 4. Panel Schematics showing all connections, between modules within panels, to all modules from field wiring with zones identified.
 - 5. Riser Diagrams indicating circuits, type of devices, number of devices, number of conductors, conduit size, junction boxes, and zones.
 - 6. Scaled floor plans with layout of all devices with point numbers for initiating and notification devices, wiring connections, zoning, wire sizes and routing.
 - a. Wattage setting for each speaker labeled adjacent to the speaker
 - b. Candela rating for each strobe labeled adjacent to the strobe
 - 7. Detailed Legend
 - 8. Fire safety and related symbols shown on Drawings and diagrams shall comply with NFPA 170.
 - 9. Detailed input/output matrix.
- B. Product Data: Provide electrical characteristics, connection requirements and compatibility listing showing that components are compatible with each other including but not limited to:
 - 1. Full equipment list including model numbers and quantities
 - 2. Complete system operation
 - 3. Highlighted Data Sheets on Devices and Products
 - a. Fire Alarm Control Panel
 - b. Wiring

- c. Batteries
 - d. Detectors
 - e. Manual Stations
 - f. Audible Signaling Devices
 - g. Visual Signaling Devices
 - h. Control Devices
4. Wiring diagrams of all equipment
 5. Installation instructions for all equipment
 6. Equipment testing procedures
 7. Equipment maintenance manuals
 8. Wire data sheets.
- C. System Calculations – Complete calculations shall be provided which show the electrical load on the following system components:
1. Each system power supply, including stand alone booster supplies.
 2. Standby Battery Calculations plus a 20 percent derating factor.
 3. Voltage drop calculations for each type of circuit. (Identify all mathematical formulas, variables and constants.)
 4. dB loss calculations for speaker circuits.
 5. Speaker circuit loading and amplifier loading.
 6. Strobe circuit loading.
 7. Each auxiliary control circuit that draws power from any system power supply.
- D. Software and Database Information:
1. Proposed point numbers.
 2. Labels of all addressable devices.
 3. English action messages.
 4. Add Programming rules, Equations, with comments listed.
- E. The submittal package shall be signed by State of Texas Alarm Planning Superintendent (NICET III) or signed and sealed by a Professional Engineer (P.E.) registered in the State of Texas.
- F. The Contractor shall provide a signed "Fire Alarm Certification and Description" for each system, consisting of completed copies of the appropriate pages from NFPA 72, at the final Acceptance Test.

- G. Provide staff installation superintendents who are licensed by the State Fire Marshal's office for such purpose and under whose supervision installation, final connections, and testing will be performed.

1.05 QUALIFICATIONS

- A. Installer Qualifications:
 - 1. Authorized and designated representative of fire alarm manufacturer to sell, install, and service proposed manufacturer's equipment. Verify equipment supplier has technical factory training specifically for the system proposed.
 - 2. Licensed by State Fire Marshal to sell, install and service fire alarm systems.
 - 3. Actively engaged in business of selling, installing, and servicing fire alarm systems for at least five years with minimum of ten such installations completed and operating properly.
 - 4. Equipment furnished shall be of current manufacture.

PART 2 PRODUCTS

2.01 FIRE ALARM CONTROL PANEL (FACP)

- A. Acceptable Manufacturers/Models:
 - 1. Honeywell Notifier.
 - 2. Edwards EST.
 - 3. Siemens.
 - 4. Simplex Grinnell.
- B. All fire alarm control panels must be intelligent, addressable Central Processing Unit (CPU) based and meets the latest edition of UL 864.
- C. All FACP's must be capable of providing circuit integrity monitoring for all Signaling Line Circuits at a level of Class A, Style 6, as defined in NFPA 72.
- D. All FACP's must be capable of providing circuit integrity monitoring of Initiating Device Circuits (IDC's) at a level of Class B as defined in NFPA 72.
- E. All FACP's must be capable of providing circuit integrity monitoring of Notification Appliance Circuits (NACs) at a level of Class B as defined in NFPA 72.
- F. Panels shall have provisions for smoke detector "Alarm Verification" for Signaling Line Circuits must be provided.
- G. Manufactured terminal boxes labeled "FIRE ALARM TERMINAL BOX" Space Age TC series or equal.
- H. With each installed field device affix a label to indicate the devices full address on its signaling line circuit.

- I. Mark each cable or wire to designated terminal with labeling tool.
- J. All FACP's must provide twenty percent (20%) excess power supply, input circuit, and output circuit capacity at final acceptance to allow for future expansion by the Owner.
- K. Zone labeling must be textual by alpha-numeric display at the FACP and remote annunciator to allow "first response" by persons not trained in fire alarm technology.
- L. Textual (alpha-numeric) language must be conventional, concise, clear and accurate to facilitate rapid response.
- M. All FACP's must provide a control to silence the Public Alarm to allow for maintenance and testing, and to reduce disruption.
- N. All FACP's must be connected to a Primary and Secondary Power source. The secondary power supply must be sized to provide 5 minutes of operation in alarm conditions after 24 hours of system operation in standby power. Where voice evacuation systems are utilized, 15 minutes of alarm shall be provided.
- O. All FACP's must provide a separate digital address for each initiating device to facilitate rapid response and maintenance and testing.
- P. All FACP's must provide a separate digital address for each individual flow switch.
- Q. All programming must be permanent and non-volatile to reduce outage time due to failure.
- R. All FACP's must provide a panel mounted printer to print a log of all status change activity.
- S. All FACP's must be listed and approved as the smoke detector sensitivity test set to reduce maintenance costs.
- T. All FACP's must be capable of providing drift compensation. Drift compensation is considered equal to adjustability at the detector.
- U. All FACP's must be field programmable, using internal or connected components, for all changes, alterations, modifications, additions, deletions and hardware and software upgrades.
- V. All messages shall be recorded in a female voice.
- W. All FACP's must be capable, using internal or connected components, of generating comprehensive reports for sensitivity, verification counts, address registers.
- X. Where a clean agent fire suppression system and/or pre-action sprinkler system is specified for the project, the FACP must be UL listed for releasing service the pre-action and/or clean agent system specified in Section 21 20 00. Initiating devices shall be connected to a UL listed releasing panel. All initiating, output and releasing circuits shall reside in one fire alarm control panel.
- Y. A fault isolation device shall be provided electrically between each building level. This device shall be capable of automatically isolating wire-to-wire faults on each SLC to the building level involved. The device shall be powered by the SLC loop. The device shall provide visual indication at the device of a short circuit (isolate) condition. The device shall

reset to the normal mode upon elimination of the wire-to-wire short. All fault isolation devices shall be physically located within the marshaling box for that floor.

2.02 REMOTE MONITOR

- A. All systems must be capable of interconnection to the monitoring service selected by Owner via a telephone line to monitor:
 - 1. Alarm
 - 2. Waterflow
 - 3. Supervisory
 - 4. Trouble
- B. Additional telephone line required for interconnection to the FACP.

2.03 DISTRIBUTED POWER SUPPLIES

- A. Distributed power supplies for powering Notification Appliance Circuits, beam smoke detectors, and control relays may be used.
- B. All distributed power supply inputs must be controlled by addressable interface devices located on the same floor levels as the power supply and controlled by the SLC serving the area to facilitate maintenance.
- C. The distributed power supplies must be sized to provide 5 minutes of operation in alarm after 24 hours of system operation in standby power. Where voice evacuation systems are utilized, 15 minutes of alarm must be provided after operation in standby power.

2.04 MANUAL PULL STATIONS

- A. All manual pull stations must be of the "double-action" type to reduce unintentional or vandal alarms. Pull stations required to break glass to activate are not acceptable. Provide pull stations that utilize the same key as FACP for resetting.
- B. Each manual pull station must have a unique digital address on the SLC.
- C. Where separate addressable monitor modules are used for monitoring conventional type manual pull stations, the modules are required to be installed within the manual pull station back box.

2.05 HEAT DETECTORS

- A. All heat detectors shall be fixed temperature, rate-of-rise, or combination fixed temperature and rate-of-rise, spot type.
- B. Each addressable heat detector must have a unique address on the SLC.
- C. Non-resetting detectors must give visual indication of "ALARM" condition to facilitate rapid response.

- D. Where separate addressable monitor modules are used for monitoring conventional type heat detectors, the modules are required to be installed within the heat detector junction box.

2.06 SMOKE DETECTORS

- A. All spot type smoke detectors shall be photoelectric or combination photoelectric and ionization type.
- B. Each smoke detector, whether spot-type, or projected-beam type, must have a unique digital address on the SLC.
- C. All smoke detectors must be field measurable and adjustable for sensitivity.
- D. All smoke detectors, except projected beam type, must be powered from the SLC.
- E. The FACP must function as the smoke detector sensitivity test set and must be approved and listed for that service.
- F. All smoke detectors must meet or exceed the requirements of Underwriters Laboratory Standard 268, as amended, and must be listed and approved for use with the FACP provided.

2.07 DUCT-MOUNTED SMOKE DETECTORS

- A. It is the joint responsibility of the Fire Alarm and the Mechanical Contractors to assure that all supply and return air is sampled as required per NFPA 90A. Label duct work and direction of air flow and identify the proper locations for duct detectors. Provide only addressable system duct detectors, factory installed duct detectors within the air handling unit are not acceptable.
- B. Provide remote LED indicator recessed at 8-feet in corridor walls and at rooftop unit control cabinet. Installation locations to be reviewed with the AHJ.

2.08 AIR SAMPLING SMOKE DETECTION

- A. Provide air sampling smoke detection system if required by the project.
- B. Locate air sampling ports in accordance with NFPA 72 and manufacturer's requirements.
- C. Maintain a maximum transport time of 120 seconds, or the transport time specified by the manufacturer, from the farthest sampling point, whichever is less.
- D. Utilize CPVC piping that is listed for use in air sampling systems. Label piping as required per NFPA 72.

2.09 WATERFLOW SWITCHES

- A. Fire detection/alarm systems must be interconnected to the fire sprinkler systems by waterflow switches must be set for a 60 second delay (retard) prior to the "ALARM."
- B. Each waterflow switch must be monitored for a unique digital address on the SLC.

- C. It is the responsibility of the Sprinkler Contractor to locate the waterflow switches to assure indication of water flow within the building and at each level of the building to reduce water damage.

2.10 SUPERVISORY (TAMPER) SWITCHES

- A. Connect tamper switches installed on all sprinkler or standpipe system valves to the fire alarm system to indicate closing or opening of the valves.

2.11 AUDIBLE APPLIANCES

- A. Fire alarm system audible notification appliances are required to be provided by speakers in all buildings. The fire alarm speakers will also be utilized by the mass notification system for audible notification. The fire alarm signal generated must be the distinctive three-pulse temporal pattern described by NFPA and ANSI codes.
- B. The Evacuation Signal produced by the speakers must be alternated with a custom textual message as indicated in Section 3.07 below.
- C. Provide audible systems with voice intelligibility measured in accordance with the guidelines in Annex A of IEC 60849, Sound Systems for Emergency Purposes. When tested in accordance with Annex B, Clause B1, of IEC 60849, the system shall exceed the equivalent of a common intelligible scale (CIS) score of 0.70.

2.12 VISUAL APPLIANCES

- A. All visual notification appliances must be xenon strobe, compliant with current requirements of ADA and TAS.
- B. All visual notification devices within a room or adjacent space within the field of view must be synchronized as required per NFPA 72.
- C. Strobes used in combination systems where the same strobe is used for both mass notification and fire notification shall be clear or nominal while meeting the listing requirements of UL 1971 and either have no marking or be marked with the word "ALERT" stamped or imprinted on the appliance and be visible to the public.

2.13 REMOTE ANNUNCIATOR

- A. When required by the project, an LCD remote annunciator shall be located in an open accessible area at or adjacent to the main ground level entrance to the building. The FACP may then be located in the entry foyer.
- B. Remote annunciator must display the same addressable and common signal information as the main FACP.

2.14 MONITORING DEVICES

- A. Addressable monitoring devices used to monitor contact-closure initiating devices such as waterflow switches, and tamper switches must derive power from the SLC to which they are connected.
- B. Each monitoring device must have a unique digital address on the SLC.

- C. Monitoring devices used to interface smoke detectors to the SLC shall be limited to existing spot type smoke detectors or duct-mounted smoke detectors.

2.15 CONTROL DEVICES

- A. Addressable control devices must not control more than one type of appliance/device.

- 2.16 Documentation storage shall be provided at or adjacent to (within five feet of) the FACP. This storage shall be capable of storing and securing all documents required for system maintenance and response. Storage shall be separated from all active electrical, electronic, or electromechanical parts and components. If adequate, storage may contain unconnected spare/repair parts.

PART 3 INTERCONNECTION AND OPERATION

3.01 SIGNALING LINE CIRCUITS (SLC)

- A. All FACP's must provide circuit integrity monitoring for all Signaling Line Circuits at a level of Class A, Style 6.
- B. All the following devices/appliances must be individually addressed on the SLC:
 - 1. Smoke detectors.
 - 2. Heat detectors.
 - 3. Manual stations.
 - 4. Monitor devices.
 - 5. Control devices.
 - 6. IDCs.
 - 7. Audio NACs.
 - 8. Visual NACs.

3.02 INITIATING DEVICE CIRCUITS (IDC)

- A. Initiating Device Circuits (IDCs) must be monitored at a level of Class B.

3.03 NOTIFICATION APPLIANCE CIRCUITS (NAC)

- A. All Notification Appliance Circuits (NACs) must be monitored at a level of Class B.
- B. Direct current notification appliance power provided from a distributed power supply must be controlled by a digital addressable control device on the SLC.
- C. Audible notification appliances and visual notification appliances must always be connected to separate NACs to facilitate maintenance.

3.04 AUXILIARY FUNCTIONS

- A. Locate control devices utilized for operating auxiliary functions mounted within 3 feet of the system being controlled as required per NFPA 72.

3.05 FLOOR ABOVE/FLOOR BELOW NOTIFICATION

- A. Selective evacuation shall be permitted if approved by the AHJ.
- B. In high rise structures, each level must constitute a minimum of one audio Notification Appliance Circuit and one visual Notification Appliance Circuit. NACs must be capable of initiating a general alarm or allow selectable notification.
- C. The FACP must also provide a control at the panel to allow sounding the Public Alarm throughout the structure (all-call) and activate both audio and visual notification for building evacuation at the FACP.

3.06 POSITIVE ALARM SEQUENCE

- A. Positive alarm sequencing shall be permitted.

3.07 VOICE ALARM NOTIFICATION

- A. The audible portion of the Public Alarm for all systems must be Voice Alarm. Provide speakers for annunciation of voice messages. Signals generated must be the Distinctive Evacuation Signal (three-pulse temporal pattern) alternated with a digitized custom textual message.
- B. Audible message required for voice evacuation shall be selected by Owner.
- C. The digitized audible message shall sound twice, and then the three pulse temporal pattern shall resume.
- D. The FACP shall provide a microphone and associated controls to allow voice paging to selected areas.

3.08 FAN SHUTDOWN

- A. Initiation by duct-mounted smoke detectors must cause shutdown of associated air handling units and supervisory signal at the fire alarm control panel. Motor control circuits must not be routed through the housing.
- B. The SLC must connect to a control device within three feet of the motor starter or other approved location to interrupt the motor control circuits.
- C. The control device must be assigned a unique digital address on the SLC.
- D. A "BYPASS" control must be provided at the FACP.

3.09 AUTOMATIC DOOR CONTROL

- A. Automatic Release-to-Close
 - 1. Smoke control doors normally held open electrically must be allowed to close upon any "ALARM" condition.
- B. Automatic Unlock

1. Access control doors normally electrically locked for security must unlock on any "ALARM" condition.

3.10 WIRING

- A. Basic wiring materials and installation must comply with NFPA 70.
- B. Conductor sizes must be sized in accordance with NFPA 72 and NFPA 70 to provide the minimum required voltage drop.
- C. Install wiring in conduit or raceway where required per NFPA 70.
- D. All system wiring shall be color coded in accordance with the following:
 1. Power Circuits – Black
 2. Strobe Circuits – Yellow or White
 3. One-Way Voice Speakers – Blue
 4. Signaling Line Circuits, Initiating Device Circuits, Network Communications Cable – Red
 5. Grounding Conductor – Green
- E. Circuits extending beyond buildings
 1. Where circuits are required to extend outside of the building, wiring must be provided with primary protectors in accordance with NFPA 70 Article 760 and Article 800.

PART 4 SPECIAL CONDITIONS

4.01 GENERAL

- A. It is the responsibility of the Contractor to assure that there is no disruption of Owner's normal functions during construction such as studying, testing, class, research or administration.

4.02 CONNECTING TO EXISTING SYSTEMS

- A. Operations of and connections to existing fire alarm systems must be supervised and/or coordinated by Owner.
- B. Existing systems must remain operational during modifications or additions to the existing system throughout the duration of the project.
- C. Where part or all of the existing fire alarm system is required to be demolished, remove the existing fire alarm components only after the new system installation is complete and accepted by the Fire Safety Systems Shop and FPS AHJ.

4.03 SMOKE CONTROL SYSTEM

- A. Where a smoke control system is required for the project, connect FACP to smoke control panel for initiation of smoke control system and associated dampers upon activation of sprinkler system water flow switch and/or a total coverage smoke detection system located within the area requiring smoke control. The smoke control panel, provided by others, is required to comply with UL 864 and listed as smoke control equipment. Where a smoke control system is required, the FACP shall provide the relay interface to a separate smoke control panel compatible with the Building BAS system.
- B. In the event a fire alarm control panel is to be utilized for smoke control functions, it must be listed in accordance with UL 864 as smoke control equipment.

4.04 MASS NOTIFICATION SYSTEM

- A. Include the additional equipment required to connect to the future campus wide mass notification system. Fire alarm speakers and speaker/strobes will be utilized for the audible portion of the mass notification system. Coordinate with Owner for additional requirements involving equipment and connection to mass notification system.

PART 5 TESTING

5.01 GENERAL

- A. Upon completion of the system, the Contractor must perform a complete and comprehensive test of the entire system in accordance with the provisions of NFPA 72. Contractor shall document their testing electronically using logging software commonly available.
- B. It is the responsibility of the Contractor to demonstrate to Owner that the system is installed and functions in accordance with the project documents and applicable codes.

5.02 SPECIFIC TESTS

- A. An acceptance test will be conducted at the completion of each project. The test will be the responsibility of the contractor and must be performed in strict compliance with the provisions of NFPA 72.
- B. In addition to the provisions of NFPA 72 and/or the above paragraph, it is the responsibility of the Contractor to provide all of the following:
 - 1. Smoke detector sensitivity report.
 - 2. Pressure differential readings for duct detector sample air flow.
 - 3. Closed loop resistance and EOL resistance readings for all field wiring.
 - 4. Programming volatility test.
- C. Fix Deficiencies:
 - 1. A copy of the formatted checklist shall be transmitted to the Contractor to serve as a punch-out list for the correction of the noted deficiencies. The Contractor shall notify the verifying party in writing that the deficiencies have been corrected along with a copy of the punch-out list with the corrected deficiencies initialed by the Contractor to indicate the corrections.

2. The Contractor shall provide updated certification forms as set forth in Section II Certification of this document.

D. Fire Alarm Testing Overview:

1. Note: The Owner may, at its sole option, require the assistance and/or participation of the Contractor in this testing.

Fire Alarm System Testing Overview		
	Contractor	General Contractor
I. Contractor's Test	X	X
II. Contractor's Certification	X	X
III. Fix Deficiencies	X	X
IV. Retest	X	X
V. Certification		
VI. Owner Test and Acceptance	X*	X*

END OF SECTION

ITEM NO. 111S EXCAVATION 9-26-12

111S.1 Description

This item shall govern: (1) the excavation and proper utilization or satisfactory disposal of all excavated materials, of whatever character, within the limits of the Work and (2) construction, compaction, shaping and finishing of all designated earthwork areas in accordance with the specification requirements outlined herein and in conformity with the required lines, grades and typical cross sections indicated on the Drawings or as directed by the Engineer or designated representative. When not otherwise included in the Contract Documents, this item shall include the work described in Specification Item Nos. 101S, "Preparing Right-of-way", No. 102S, "Clearing and Grubbing", No. 104S, "Removing Portland Cement Concrete", No. 132S "Embankment" and No. 201S, "Subgrade Preparation".

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

111S.2 Submittals

The submittal requirements of this specification item may include:

- A. A permit when utility adjustments are made in the right-of-way,
- B. A plan for removal and deposition of all 'Waste' materials, and
- C. A Blasting Permit if blasting is required and allowed on the project.

111S.3 Classification

All excavation shall be unclassified and shall include all materials encountered regardless of their nature or the manner in which they are removed.

111S.4 Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures shall be in place. The existing utilities shall be located and shall be protected as specified in the Standard Contracts Document Section 00700, "General Conditions" and/or indicated on the Drawings. A permit shall be required when utility adjustments are to be made in preparation for construction in the right-of-way, as specified in Section 5.2.0 of the City of Austin Utilities Criteria Manual.

Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed, that conform to Specification Item No. 610S, "Preservation of Trees and Other Vegetation".

All excavation shall be performed as specified herein and shall conform to the established alignment, grades and cross sections indicated on the Drawings. Suitable excavated materials shall be utilized, insofar as practical, in constructing required embankments. The construction of all embankments shall conform to Specification Item No. 132S, "Embankment". No material shall be stockpiled within the banks of a waterway.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor. Unsuitable material encountered below the subgrade elevation in roadway cuts, when declared "Waste" by the Engineer or designated representative, shall be replaced with

material from the roadway excavation or with other suitable material as approved by the Engineer. It shall become the Contractor's responsibility to dispose of this material off the limits of the right-of-way in an environmentally sound manner at a permitted disposal site.

All blasting shall conform to the Provisions of the Standard Contract Document Section 01550, "Public Safety and Convenience". In all cases, a Blasting Permit must be obtained in advance from the City of Austin, Public Works Department.

Adequate dewatering and drainage of excavation shall be maintained throughout the time required to complete the excavation work.

111S.5 Measurement

All accepted excavation will be measured by either Method A or B as follows:

(1) Method A

Measurement of the volume of excavation in cubic yards (cubic meters: 1 cubic meter is equal to 1.308 cubic yards) by the average end area methods. Cross-sectional areas shall be computed from the existing ground surface to the established line of the subgrade, as shown on typical sections in the Drawings, over the limits of the right-of-way or other work limits, including parkway slopes and sidewalk areas.

(2) Method B

Measurement of the volume of excavation in cubic yards (cubic meters: 1 cubic meter is equal to 1.308 cubic yards) based upon the average end area method taken from pre-construction cross sections and planned grades. The planned quantities for excavation will be used as the measurement for payment for this item.

111S.6 Payment

This item will be paid for at the contract unit bid price for "Excavation", as provided under measurement Method A or B as included in the bid. The bid price shall include full compensation for all work herein specified including dewatering, drainage, subgrade preparation, unless otherwise indicated, and the furnishing of all materials, equipment, tools, labor and incidentals necessary to complete the work.

Payment will be made under one of the following:

Pay Item No. 111S-A:	Excavation	Per Cubic Yard.
Pay Item No. 111S-B:	Excavation, Plan Quantity	Per Cubic Yard.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
Specification Item 111S, "EXCAVATION"	
<u>City of Austin Standard Contract Documents</u>	
<u>Designation</u>	<u>Description</u>
00700	General Conditions
01550	Public Safety and Convenience
<u>City of Austin Utilities Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 5.2.0	Permit for Excavation in the Public Right-of-Way

<u>City of Austin Technical Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right-of-way
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Portland Cement Concrete
Item No. 132S	Embankment
Item No. 201S	Subgrade Preparation
Item No. 236S	Proof Rolling
Item No. 610S	Preservation of Trees and Other Vegetation

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 111S, "EXCAVATION"</u>	
<u>City of Austin Standard Contract Documents</u>	
<u>Designation</u>	<u>Description</u>
01500	Temporary Facilities
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 120S	Channel Excavation
Item No. 203	Lime Treatment for Materials In Place
Item No. 204S	Portland Cement Treatment for Materials In Place
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 234S	Rolling (Tamping)
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 622S	Diversion Dike
Item No. 628S	Sediment Containment Dikes
Item No. 642S	Silt Fence
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 610S-1	Tree Protection Fence Locations
No. 610S-2	Tree Protection Fence, Type B Chainlink
No. 610S-3	Tree Protection Fence, Type B Wood
No. 610S-4	Tree Protection Fence, Modified Type A
No. 610S-5	Tree Protection Fence, Modified Type B
No. 621S-1	Diversion
No. 622S-1	Diversion Dike
No. 624S-1	Earth Outlet Sediment Trap
No. 625S-1	Grade Stabilization Structure
No. 627S-1	Grass Lined Swale
No. 627S-2	Grass Lined Swale With Stone Center
No. 628S	Triangular Sediment Filter Dike
No. 628S-1	Hay Bale Dike
No. 629S-1	Brush Berm
No. 630S-1	Interceptor Dike

No. 631S-1	Interceptor Swale
No. 632S-1	Storm Inlet Sediment Trap
No. 633S-1	Landgrading
No. 634S-1	Level Spreader
No. 635S-1	Perimeter Dike
No. 636S-1	Perimeter Swale
No. 637S-1	Pipe Slope Drain (Flexible)
No. 637S-2	Pipe Slope Drain (Flexible)
No. 638S-1	Pipe Outlet Sediment Trap
No. 639S-1	Rock Berm
No. 641S-1	Stabilized Construction Entrance
No. 642S-1	Silt Fence
No. 643S-1	Stone Outlet Structure
No. 644S-1	Stone Outlet Sediment Trap
<u>The Code of the City of Austin, Code of Ordinances, Volume 1</u>	
<u>Designation</u>	<u>Description</u>
Article 15-12-166	Permit Required
Article 15-12-173	Conditions for Permit Issuance
Article 15-12-174	Permit Term
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-way
Item No. 110	Excavation
Item No. 112	Subgrade Widening
Item No. 132	Embankment
Item No. 150	Blading
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)
Item No. 260	Lime Treatment for Materials Used as Subgrade (Road Mixed)
Item No. 265	Lime-Fly Ash (LFA) Treatment for Materials Used as Subgrade
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic Limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

ITEM NO. 130S BORROW 9-26-12

130S.1 Description

This item shall govern required excavation, removal and proper utilization of materials secured from sources, selected by the Contractor and approved by the Engineer or designated representative. The compaction of embankments constructed from borrow as provided herein shall conform to the appropriate sections of Specification Item Nos. 132S, "Embankment" and 236S, "Proof Rolling".

Borrow will be used only when indicated on the Drawings or directed by the Engineer or designated representative and shall only be acquired from approved sources.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

130S.2 Submittals

The submittal requirements of this specification item may include:

- A. Identification of Class, source and characteristics (P.I., linear shrinkage, etc.) of proposed borrow material, and
- B. A plan for managing and maintaining borrow sites.

130S.3 Materials

All authorized borrow shall conform to one of the following classes:

Class A (Select Borrow)

Class A Borrow material shall consist of suitable granular material, free from vegetation or other objectionable matter and reasonably free from lumps of earth. When tested by standard TxDOT laboratory methods Tex-105-E, Tex-106-E and Tex-107-E, the Class A Select Borrow, shall meet the following requirements:

The Liquid Limit shall not exceed	45
The Plasticity Index shall not exceed	15
The bar linear shrinkage shall not be less than	2

Class B (Borrow)

Class B Borrow material shall consist of suitable non swelling [i.e. soils with a plasticity index (P.I.) less than 20] earth material such as loam, clay or other such materials that will form a stable embankment.

Class C (Topsoil) See Standard Specification Item No. 601S.3(A)

Class C Borrow material shall consist of approved soils, which shall be clean, friable and capable of supporting plant life. This material shall also be free of stones and all other debris.

130S.4 Construction Methods

Prior to commencing this work, all required erosion control and environmental measures shall be in place. All suitable materials removed from excavations shall be used, insofar as practicable in the formation of

embankments conforming to Specification Item No. 132S, "Embankment", as otherwise indicated on the Drawings or as directed by the Engineer or designated representative. The completed work shall conform to the established alignment, grades and cross section as shown on the Drawings. The additional material necessary to complete the work described above shall be "Borrow" of the class specified.

The Contractor shall arrange for borrow from one of the following sources:

1. Existing borrow pit,
2. New borrow pit, or
3. Surplus excavated material from a site, with a site development permit.

The Contractor shall notify the Engineer 3 weeks prior to opening a pit or any other borrow source to allow necessary testing for approval of materials. All borrow sites shall comply with the requirements of the site development permit.

During construction, borrow sources shall be kept drained to permit final cross sections to be measured, when required.

Borrow sites shall be managed and maintained to minimize the impact of the appearance of the natural topographic features and at no time create a potential hazard to the public.

130S.5 Measurement

Borrow will be measured by the cubic yard (cubic meters: 1 cubic meter is equal to 1.196 cubic yards) in its final position based upon the average end areas, calculated from pre-construction cross sections and plan grades. The pay quantities for Borrow or Topsoil will be used as the measurement for payment for this item.

130S.6 Payment

All work performed as required herein and measured as provided under "Measurement" will be paid for at the unit bid price. The bid prices shall include full compensation for furnishing all labor; all materials; all royalty and freight involved; all hauling and delivering on the road; and all tools, equipment and incidentals necessary to complete the work. Payment will not be made for unauthorized work.

Payment will be made under one of the following:

Pay Item No. 130S-A:	Class A (Select Borrow), Plan Quantity	Per Cubic Yard.
Pay Item No. 130S-B:	Class B (Borrow), Plan Quantity	Per Cubic Yard.
Pay Item No. 130S-T:	Class C (Topsoil), Plan Quantity	Per Cubic Yard.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 130S, "BORROW"</u>	
City of Austin Standard Specifications	
<u>Designation</u>	<u>Description</u>
Item No. 132S	Embankment
Item No. 236S	Rolling (Proof)
Texas Department of Transportation: Manual of Testing Procedures	
<u>Designation</u>	<u>Description</u>

Tex-105-E	Determination of Plastic Limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-107-E	Determination of Bar Linear Shrinkage of Soils

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 130S, "BORROW"</u>	
<u>City of Austin Standard Contract Documents</u>	
<u>Designation</u>	<u>Description</u>
00700	General Conditions
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right-of-way
Item No. 102S	Clearing and Grubbing
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 234S	Rolling (Tamping)
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 622S	Diversion Dike
Item No. 628S	Sediment Containment Dikes
Item No. 642S	Silt Fence
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 610S-1	Tree Protection Fence Locations
No. 610S-2	Tree Protection Fence, Type B Chainlink
No. 610S-3	Tree Protection Fence, Type B Wood
No. 610S-4	Tree Protection Fence, Modified Type A
No. 610S-5	Tree Protection Fence, Modified Type B
No. 621-1	Diversion
No. 622-1	Diversion Dike
No. 624-1	Earth Outlet Sediment Trap
No. 625-1	Grade Stabilization Structure
No. 626-1	Grass Lined Swale
No. 627-1	Grass Lined Swale With Stone Center
No. 628S	Triangular Sediment Filter Dike
No. 628S-1	Hay Bale Dike
No. 629S-1	Brush Berm
No. 630S-1	Interceptor Dike
No. 631S-1	Interceptor Swale
No. 632S-1	Storm Inlet Sediment Trap
No. 633S-1	Landgrading

No. 634S-1	Level Spreader
No. 635S-1	Perimeter Dike
No. 636S-1	Perimeter Swale
No. 637S-1	Pipe Slope Drain (Flexible)
No. 637S-2	Pipe Slope Drain (Flexible)
No. 638S-1	Pipe Outlet Sediment Trap
No. 639S-1	Rock Berm
No. 641S-1	Stabilized Construction Entrance
No. 642S-1	Silt Fence
No. 643S-1	Stone Outlet Structure
No. 644S-1	Stone Outlet Sediment Trap
Texas Department of Transportation: <u>Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)
Texas Department of Transportation: <u>Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

ITEM NO. 132S EMBANKMENT 8-20-07

132S.1 Description

This item shall govern the placement and compaction of suitable materials obtained from approved sources for utilization in the construction of street or channel embankments, berms, levees, dikes and structures. When not otherwise included in the Contract Documents or indicated on the Drawings, this item shall include the work described in Specification Item Nos. 101S, "Preparing Right-of-way", 102S, "Clearing and Grubbing", 104S, "Removing Portland Cement Concrete", 201S, "Subgrade Preparation" and No. 236S, "Proof Rolling."

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

132S.2 Submittals

The submittal requirements of this specification item may include:

- A. A plan identifying source, material type, classification and characteristics (P.I., optimum moisture-density, etc.) of the proposed embankment material,
- B. Type and size of equipment proposed to produce the required compaction, and
- C. Compaction (Density-moisture, etc) test results for in-place embankment layers.

132S.3 Construction Methods

A. General

Prior to the placement of any embankment, all tree protection and tree wells and erosion control devices shall be in place and all operations involving Standard Specification Item No. 101S, "Preparing Right-of-way" and/or Standard Specification Item No. 102S, "Clearing and Grubbing" shall have been completed for the areas over which the embankment is to be placed. Stump holes or other small excavations encountered within the limits of the embankments shall be backfilled with suitable material and thoroughly tamped by approved methods before commencement of the embankment construction.

The area of embankment placement shall be proof rolled (Specification Item No. 236S, "Proof Rolling") and any unstable or spongy areas shall be undercut and backfilled with suitable material or otherwise mechanically manipulated and compacted by approved methods. Where shown on the Drawings or required by the Engineer or designated representative, the ground surface thus prepared shall be compacted by sprinkling and rolling. The surface of the ground, including those plowed and loosened or roughened by small washes, shall be restored to approximately its original slope and the ground surface thus prepared shall be compacted by sprinkling and rolling.

Construction equipment shall not be operated within the drip line of trees, unless otherwise indicated. Construction materials shall not be stockpiled under the canopies of trees. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed in accordance with Item No. 610S, "Preservation of Trees and Other Vegetation".

Unless otherwise indicated on the Drawings and with the exception of rock, the surface of the ground of all unpaved areas, which are to receive embankment, shall be loosened by scarifying or plowing to a depth of not less than 4 inches (100 mm). The loosened material shall be re-compacted with the new embankment as hereinafter specified.

The surface of hillsides, which are to receive embankment, shall be loosened, by scarifying or plowing, to a depth of not less than 4 inches (100 mm) and benches constructed before the embankment materials are placed. The embankment shall then be placed in layers, as hereinafter specified, beginning at the low side with partial width layers and increasing the widths of the layers as the embankment is raised. The material, which has been loosened during preparation of the original ground surface, shall be re-compacted simultaneously with the embankment material placed at the same elevation.

Where embankments are to be placed adjacent to or over existing roadbeds, the roadbed slopes shall be plowed or scarified to a depth of not less than 6 inches (150 mm) and the embankment along the roadbed slopes shall be built up in successive layers, as hereinafter specified, to the elevation of the old roadbed. Then, if specified, the top surface of the old roadbed shall be scarified to a minimum depth of 6 inches (150 mm) and re-compacted along with the next layer of the new embankment. The total depth of the scarified and added material shall not exceed the permissible layer depth, specified hereinafter.

Trees, stumps, roots, vegetation or other unsuitable materials shall not be placed in embankment.

All embankment shall be constructed in layers approximately parallel to the finished grade and unless otherwise indicated, each layer shall be so constructed as to provide a uniform slope of 1/4 inch per foot (20 mm per meter) from the centerline of the roadbed to the outside. In the case of superelevated curves, each layer shall be constructed to conform to the specified superelevation or cross slope.

The embankment shall be continuously maintained at its finished section and grade until that portion of the work is accepted. After completion of the embankment to the finished section and grade, the Contractor shall proof roll the subgrade or finished grade in accordance with Specification Item No. 236S, "Proof Rolling". Any unstable or spongy areas shall be undercut and backfilled with suitable material or otherwise mechanically manipulated and compacted by approved methods. After acceptance of the embankment, re-vegetation activities shall commence immediately to minimize the soil loss and air pollution.

B. Earth Embankments

Earth embankments shall be defined as embankments composed of soil material other than rock and shall be constructed of acceptable material from approved sources.

Unless directed otherwise, earth embankments shall be constructed in successive layers, with a thickness of 8 inches (200 mm) or less in loose measure, for the full width of the individual cross section and in a length that is best suited to the sprinkling and compaction methods utilized.

Minor quantities of rocks with a maximum dimension of 4 inches (100 mm) may be incorporated in the earth embankment layers, provided that the rock is not placed immediately adjacent to structures.

Each layer of embankment shall be uniform as to material type and classification, density and moisture content before beginning compaction. Where layers of unlike materials abut each other, each layer shall be feathered on a slope of 1:20 or the materials shall be so mixed as to prevent abrupt changes in the soil. Any material placed in the embankment by dumping in a pile or windrows shall not be incorporated in a layer in that position. All such piles or windrows shall be incorporated in an embankment layer by blading and mixing or by similar methods. Clods or lumps of material shall be broken down into smaller sizes and the embankment material in a layer shall be mixed by blading, harrowing, discing or similar methods to insure that a uniform material of uniform density is secured in each layer.

The water required in sprinkling the layers, to obtain the moisture content necessary for optimum compaction, shall be evenly applied. It shall be the responsibility of the Contractor to secure uniform moisture content throughout the layer by such methods as may be necessary.

All earth cuts, whether full width or partial width side hill cuts and which are not required to be excavated below the subgrade elevation, shall be scarified to a uniform depth of at least 6 inches (150 mm) below grade. The material shall be mixed and reshaped by blading, sprinkled and rolled in accordance with the

requirements outlined above for earth embankments to the same density required for the adjacent embankment.

Compaction of embankments shall conform to Item No. 201S, "Subgrade Preparation". Each layer shall be compacted to the required density by any method, and/or type and size of equipment, which will produce the required compaction. Prior to and in conjunction with the rolling operation, each layer shall be brought to the moisture content necessary to obtain the required density and shall be kept leveled with suitable equipment to insure uniform compaction over the entire layer.

It is the intent of this specification to provide the required density and moisture control for each layer of earth embankment and select material based on the plasticity characteristics of the embankment soil. Each layer shall be sprinkled as required and compacted to the extent necessary to provide the density specified below, unless otherwise indicated.

Description	Density, Percent	Moisture
Non-swelling Soils (PI less than 20)	Not less than 95	
Swelling Soils (PI between 20 and 35)	Not less than 95 nor more than 102	Not less than optimum
Swelling Soils (P.I. greater than 35)	Not less than 95 nor more than 100	Not less than optimum

The Plasticity Index (PI) will be established in accordance with TxDOT Test Methods Tex-104-E, Tex-105-E and Tex-106-E and the density determination will be made in accordance with TxDOT Test Method Tex-114-E, "Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade and Embankment Soil". Field density measurements will be made in accordance with TxDOT Test Method Tex-115-E, "Field Method for Determination of In-Place Density of Soils and Base Materials".

After each layer of earth embankment or select material is complete, tests, as necessary, will be conducted as directed by the Engineer or designated representative. If the material fails to meet the density specified, the course shall be reworked as necessary to obtain the specified compaction.

C. Rock Embankments

Rock embankments shall be defined as those composed principally of rock and shall be constructed of accepted material from approved sources. Rock embankments shall not be placed immediately adjacent to structures.

Except as otherwise indicated on the Drawings, rock embankments shall be constructed in successive layers of 18 inches (450 mm) or less in thickness for the full width of the cross section. When, in the opinion of the Engineer or designated representative, the rock sizes necessitate a greater thickness of layer than specified, the layer thickness may be increased as necessary, but in no case shall the thickness of layer exceed 2½ feet (750 mm). Each layer shall be constructed by starting at one end and dumping the rock on top of the layer being constructed then pushing the material ahead with a bulldozer in such a manner that the larger rock will be placed on either the ground or the preceding embankment layer. Each layer shall be constructed in such a manner that the interstices between the larger stones are filled with small stones and spalls which have been created by this operation and from the placement of succeeding layers of material.

The maximum dimension of any rock used in embankment shall be less than the thickness of the embankment layer and in no case shall any rock over 2 feet (600 mm) in its greatest dimension be placed in the embankment, unless otherwise approved by the Engineer or designated representative. All oversized rocks, which are otherwise suitable for construction, shall be broken to the required dimension and utilized in embankment construction where indicated. When preferred by the Contractor and acceptable to the Engineer or designated representative, oversized rocks may be placed at other locations where the embankment layer is of greater depth, thus requiring less breakage.

Each layer shall be compacted to the required density as outlined for "Earth Embankments", above, except in those layers where rock will make density testing difficult, the Engineer or designated representative may accept the layer by visual inspection or proof rolling conforming to Specification Item No. 236S, "Proof Rolling)".

Unless otherwise indicated, the upper 3 feet (1 meter) of the embankment shall not contain stones larger than 4 inches (100 mm) in their greatest dimension and shall be composed of material so graded that the density and uniformity of the surface layer may be secured in accordance with TxDOT Test Method Tex-114-E.

Exposed oversize material shall be broken up or removed.

D. At Culverts and Bridges

Embankment materials, which are to be placed adjacent to culverts and bridges and cannot be compacted by the blading and rolling equipment that was used in compacting the adjoining sections of embankment, shall be compacted in the manner prescribed under Item No. 401, "Structural Excavation and Backfill".

Embankment constructed around 'spill through' type abutments shall be constructed in 6 inch (150 mm) loose layers of a uniform suitable material and shall be placed so as to maintain approximately the same elevation on each side of the abutment. All materials shall be mixed, wetted and compacted as specified above. Embankment material placed adjacent to any portion of a structure or above the top of any culvert or similar structure shall be free of any appreciable amount of gravel or stone particles and shall be thoroughly compacted by mechanical compaction equipment.

132S.4 Measurement

All accepted embankment, when included in the contract as a separate pay item, will be measured in place and the volume computed in cubic yards (cubic meters: 1 cubic meter is equal to 1.196 cubic yards) by the method of average end areas. No allowance shall be made for shrinkage.

132S.5 Payment

The work and materials presented herein will generally not be paid for directly, but shall be included in the unit price bid for the item of construction in which this item is used. However, when specified in the contract bid form as a separate pay item, it shall be paid for at the contract unit bid price for "Embankment". The bid price shall include full compensation for all work herein specified, including the furnishing of all materials, (except "Borrow" when paid as a separate bid item) compaction, equipment, tools, labor, water for sprinkling, proof rolling and incidentals necessary to complete the work.

Payment, when included in the contract as a separate pay item, will be made under:

Pay Item No. 132S-A:	Embankment	Per Cubic Yard.
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End

SPECIFIC CROSS REFERENCE MATERIALS	
Specification 132S, "EMBANKMENT"	
City of Austin Standard Specifications	
Designation	Description
Item No. 101S	Preparing Right-of-way
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Portland Cement Concrete

Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 130S	Borrow
Item No. 201S	Subgrade Preparation
Item No. 236S	Proof Rolling
Item No. 401	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation
Texas Department of Transportation: <u>Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic Limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-107-E	Determination of Bar Linear Shrinkage of Soils
Tex-114-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 132S, "EMBANKMENT"</u>	
<u>City of Austin Standard Contract Documents</u>	
<u>Designation</u>	<u>Description</u>
00700	General Conditions
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 234S	Rolling (Tamping)
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 622S	Diversion Dike
Item No. 628S	Sediment Containment Dikes
Item No. 642S	Silt Fence
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 610S-1	Tree Protection Fence Locations
No. 610S-2	Tree Protection Fence, Type B Chainlink
No. 610S-3	Tree Protection Fence, Type B Wood
No. 610S-4	Tree Protection Fence, Modified Type A
No. 610S-5	Tree Protection Fence, Modified Type B
No. 621S-1	Diversion
No. 622S-1	Diversion Dike
No. 624S-1	Earth Outlet Sediment Trap

No. 625S-1	Grade Stabilization Structure
No. 627S-1	Grass Lined Swale
No. 627S-2	Grass Lined Swale With Stone Center
No. 628S	Triangular Sediment Filter Dike
No. 628S-1	Hay Bale Dike
No. 629S-1	Brush Berm
No. 630S-1	Interceptor Dike
No. 631S-1	Interceptor Swale
No. 632S-1	Storm Inlet Sediment Trap
No. 633S-1	Landgrading
No. 634S-1	Level Spreader
No. 635S-1	Perimeter Dike
No. 636S-1	Perimeter Swale
No. 637S-1	Pipe Slope Drain (Flexible)
No. 637S-2	Pipe Slope Drain (Flexible)
No. 638S-1	Pipe Outlet Sediment Trap
No. 639S-1	Rock Berm
No. 641S-1	Stabilized Construction Entrance
No. 642S-1	Silt Fence
No. 643S-1	Stone Outlet Structure
No. 644S-1	Stone Outlet Sediment Trap
Texas Department of Transportation: <u>Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
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Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Texas Department of Transportation: <u>Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
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Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)
Texas Department of Transportation: <u>Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-107-E	Determination of Bar Linear Shrinkage of Soils

SECTION 32 31 18 CANTILEVER SLIDE GATE WITH VERTICAL LOUVERED INFILL

PART 1 – GENERAL

1.01 DESCRIPTION

- A. This section describes the following fence system:
 - 1. Fixed louver modular panels fabricated and installed in aluminum cantilever slide gates. Louvered slide gates shall be furnished and installed as shown on the plans and specified herein, overall height, opening and total width of gates shall be as shown on the plans

1.02 BASIC REQUIREMENTS

- A. Furnish materials, labor, expertise and equipment necessary to complete all work specified in this section and as shown on the drawings.

1.03 SUBMITTALS

- A. Shop drawings and manufacturer's literature: Provide specifications and construction detail drawings to substantiate quality of materials and provide details of fabrication and installation.
- B. Submittals shall be in accordance with Section 01 33 00.
- C. Certificate: manufacturer's certification that materials meet specification requirements.

1.04 REFERENCES

- A. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- B. ASTM B 221 – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
- C. ASTM D3363 – Standard Test Method for Film Hardness by Pencil Test.
- D. ASTM D2794 – Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation.
- E. ASTM B117 – Standard Practice for Operating Salt Spray Apparatus.
- F. ASTM D822 – Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- G. FS RR-191/2D Type III & IV – Federal Specification for Cantilever Slide Gates
- H. ASTM F 1184-88 Standard Specification for Industrial and Commercial Horizontal Slide Gates

- I. ASTM F 2200 Standard Gate Construction

1.05 QUALITY ASSURANCE

- A. Installation of fence and materials shall conform to the requirements of the fence manufacturer.
- B. The fence shall be warranted from any defects in materials and workmanship for a period as specified in the relevant section of the contract documents.

PART 2 – PRODUCTS

2.01 MANUFACTURER AND PRODUCT

- A. Basis of Design: Contract Documents are based on manufacturer and products named under each item below to establish a standard of quality. Other manufacturers with products having equivalent characteristics may be considered, provided deviations are minor and do not change concept as expressed in Contract Documents as judged by Architect.

1. Manufacturer: PalmSHIELD
 - a. Product: Tiger Slide Gate.

2.02 MATERIALS

- A. Material Descriptions:

1. Extruded Aluminum: ASTM B 221, Alloy 6063 – Temper T-6.
2. Sheet Aluminum: ASTM B211, Alloy 6063 – Temper T6.
3. Powder Coating Material Hardness: ASTM 3363 2H.

- B. Louver Panel Description:

1. Panel Height: Refer to drawings.
2. Louver Panel Width. Not to exceed 60 inches.
3. Fixed Vertical Louver Angles: 1 ¾ inches by 1 ¾ inches by 0.1250 inch thick angle louver nested and spaced 1 5/8 inches on center.
4. Louver Vertical Framework: 3 inch by 3 inch by ¼ inch aluminum angle. Framework supporting the louvers shall be solid welded and mitered.
5. Louver Horizontal Top Cap: 3 inch by 3 inch by ¼ inch aluminum top cap.
6. Louver Horizontal Bottom Cap: 3 inch by 3 inch by ¼ inch angle bottom cap.
7. Cross Bar: 2 inch by 1/8 inch aluminum flat bar.

8. Fittings and accessories: All fittings and accessories shall be stainless steel and sized as specified by the fence manufacturer.

C. Gate: Cantilever Slide

1. Fully Fabricated Gate: The gate shall be fully shop fabricated in its largest possible sections. All gate frames, supports and tracks are to be joined by welded connections.
2. Materials: The frame(s) and track(s) are to be fabricated from aluminum extrusions (6063-T6).
3. Single track applications provide an upper track that weighs 5.15 pounds per foot.
 - a. Double track applications provide an upper track that weighs 11.916 pounds per foot.
4. The entire gate shall receive fully trussed. Trussing may be established by 3/16 inch galvanized cable in "X" pattern throughout the opening and tail section of the gate. All cable assemblies will be equipped with field adjustable tension devices. All trussing will be placed behind the panels.
5. The vertical supports of the gate shall be 2 inch by 4 inch and shall not be spaced greater than six feet on center and will not exceed the height of the gate.
6. The bottom track shall be 2 inch by 4 inch. For openings greater than 20 feet' bottom rail shall be 5 inch by 2 inch.
7. Once gate is fully fabricated and trussing is installed and tensioned, panels shall be installed in-between vertical uprights. Panels will be welded in place.

D. Gate Hardware

1. Gate truck assemblies shall be tested for continuous duty and shall have precision ground and hardened components. Bearings shall be pre-lubricated and contain shock resistant outer races and captured seals.
2. Gate truck assemblies shall be supported by a minimum 5/8 inch plated steel bolt with self aligning capability, rated to support a 2,000 pound reaction load.
3. Hanger brackets shall be hot dipped galvanized steel with a minimum 3/8 inch thickness that is also gusseted for additional strength.
4. Gate top track and supporting hangar bracket assemblies shall be certified by a licensed professional engineer to withstand a 2,000 pound vertical reaction load without exceeding allowable stresses.

E. Factory Finish: Aluminum fence panels, posts and gates shall receive polyester powder coating.

1. Polyester powder coating: Electrostatically applied colored polyester powder coating

heat cured to chemically bond finish to metal substrate.

- a. Color shall be as selected by Architect.
- b. Minimum hardness measured in accordance with ASTM D3363 2H.
- c. Direct impact resistance tested in accordance with ASTM D2794. Withstand 160 inch-pounds.
- d. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity after 1,000 hours, less than 3/16 inches undercutting.
- e. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted 45°.

PART 3 – EXECUTION

3.01 INSPECTION

- A. Verify that final grading in gate location is completed and without irregularities which will interfere with gate installation.
- B. Field verify all gate dimensions and layout prior to commencing installation.
- C. Do not commence work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Gate posts are to be installed inside and behind the gate. See manufacture instructions on placement of posts. Gate post footings or attachment are to be reviewed and engineered by cantilever gate manufacturer relative to gate size, weight and field conditions.
 1. Coordinate gate post footings with paving.
- B. Install gate in accordance with manufacturer's installation instructions.
- C. Install gate plumb and level.
- D. Do not install bent, bowed or otherwise damaged panels. Remove damaged components from site and replace.
- E. Adjust hardware for smooth operation.

END OF SECTION

SECTION 32 84 00 – LANDSCAPE IRRIGATION

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes piping, valves, sprinklers, accessories, controls, and wiring for automatic-control irrigation system.

1.02 DEFINITIONS

- A. Irrigation Lateral Lines: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.
- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. Irrigation Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

1.03 SUBMITTALS

- A. Product Data: Include pressure ratings, rated capacities, and settings of selected models for the following:
 - 1. General-duty valves.
 - 2. Specialty valves.
 - 3. Control-valve boxes.
 - 4. Sprinklers.
 - 5. Irrigation accessories.
 - 6. Controllers.
- B. Shop Drawings: Show irrigation system piping, including plan layout, and locations, types, sizes, capacities, and flow characteristics of irrigation system piping components. Include water meters, backflow preventers, valves, piping, sprinklers, accessories, controls, and wiring. Show areas of sprinkler spray and overspray. Show wire size and number of conductors for each control cable.
- C. Record and as-built drawings:
 - 1. The Contractor shall provide and keep up to date and complete "as-built" record set of prints which shall be corrected daily and show every change from original drawings and specifications and the exact "as-built" locations, sizes, and kinds of equipment. Prints of this purpose may be obtained from the Architect at cost. This set of drawings shall be kept on the site and shall be used only as a record set.
 - 2. These drawings shall also serve as work progress sheets and shall be the basis for measurement and payment for work completed. These drawings shall be available at

all times for inspection and shall be kept in a location designated by the Architect. Should the record blue line as-built progress sheets not be available for review or not up-to-date at the time of any inspection (refer to Section 3.10 – Inspection Schedule), it will be assumed no work has been completed and the Contractor will be assessed the cost of that site visit at the current billing rate of the Architect. No other observations shall take place prior to payment of that assessment.

3. The Contractor shall make neat and legible notations on the as-built progress sheets daily as the work proceeds, showing the work as actually installed.
4. Before the date of the final inspection, the Contractor shall transfer all information from the “as-built” prints to a Mylar. All work shall be in waterproof ink and applied to the Mylar by a technical pen made expressly for use on Mylar material. Contractor shall use symbols and notation consistent with original drawings.
5. The Contractor shall dimension from two (2) permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following items:
 - a. Connection to existing water lines.
 - b. Connection to existing electrical power.
 - c. Gate valves.
 - d. Routing of sprinkler pressure lines (dimensions max. 100' along routing).
 - e. Sprinkler control valves.
 - f. Routing of control wiring.
 - g. Quick coupling valves.
 - h. Other related equipment as directed by the Architect.
6. The final as-built provided by the Contractor shall be CAD generated. The landscape Architect will provide their CAD base file for the Contractor to use as his starting point. The final CAD file provided by the Contractor shall be completely bound (xrefs) and purged.

D. Controller Charts:

1. As-built drawings shall be approved by the Architect before controller charts are prepared.
 - a. Index sheet stating Contractor's address and telephone number, list of equipment with name and addresses of local manufacturer's representative.
 - b. Catalog and parts sheets on every material and equipment installed under this contract.
 - c. Guarantee statement.
 - d. Complete operating and maintenance instruction on all major equipment.

E. Operation and maintenance instructions.

- F. Spares and Special Tools: Provide owner with two (2) spare sprinkler heads of each size and type.
- G. Water use budget for the system that includes each zone. Water use must comply with jurisdiction requirements.

1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marketed for intended use.
- B. Installer: Installation of irrigation system shall be performed under the direction of a State of Texas licensed irrigator with not less than five (5) years' experience in this type of work.
- C. Manufacturer's Directions: Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturer's articles used in this contract furnish directions covering points not shown in the drawings and specifications.
- D. Ordinances, Codes, and Regulations: All local, municipal and state laws, and rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in the specifications shall be constructed to conflict with any of the above rules and regulations and requirements of the same. However, when these specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, these specifications and drawings shall take precedence.
- E. Explanation of Drawings:
 - 1. Due to the scale of drawings, it is not possible to indicate all offsets, fittings, sleeves, etc., which may be required. The Contractor shall carefully investigate the structural and finished conditions affecting all of his work and plan his work accordingly, furnishing such fittings, etc., as may be required to meet such conditions. Drawings are generally diagrammatic and indicative of the work to be installed, the work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.
 - 2. The word Architect as used herein shall refer to the owner's authorized representative of the landscape Architect.
 - 3. All work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications.
 - 4. The Contractor shall not willfully install the irrigation system as shown on the drawing when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differenced should be brought to the attention of the owner's authorized representative. In the event this notification is not performed, the irrigation Contractor is to assume full responsibility for any revisions necessary.

1.05 PRODUCT DELIVERY AND HANDLING

- A. Materials shall be delivered in manufacturer's unopened packaging labeled to indicate manufacturer's name and product identification. Ensure that packaging and labeling remain intact until installation. Materials shall be stored protected from the elements, including direct sunlight.
- B. Pipes shall be handled so as to prevent being damaged and to maintain their straightness. Pipe end shall be wrapped. Pipes shall be stored on beds the full length of the pipes. Damaged or dented pipes or fittings shall not be used.

1.06 SUBSTITUTIONS

- A. If the irrigation Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the irrigation drawings and specifications, he may do so by providing the following information to the owner's authorized representative for approval:
 - 1. Provide a statement indicating the reason for making the substitution. Use a separate sheet of paper for each item to be substituted.
 - 2. Provide descriptive catalog literature, performance charts, and flow charts for each item to be substituted.
 - 3. Provide the amount of cost savings if the substituted item is approved.
- B. Owner's authorized representative shall have the sole responsibility in accepting or rejecting any substituted item as an approved equal to those equipment and materials listed on the irrigation drawings and specifications.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. When a conflict exists between products on the drawings and products on the specifications, refer to the drawings.

2.02 PIPES, TUBES, AND FITTINGS

- A. Soft Copper Tube: ASTM B 88, Type L, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- B. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- C. Mainline PVC Pipe: ASTM D 1785, PVC 1120 compound, schedule 40.
1. Pressure Main Line:
 - a. Pressure main line piping 4" and larger shall be class 200 rubber gasket pipe and 3" smaller shall be PVC schedule 40 with solvent welded joints.
 - b. Pipe shall be made from an NSF approved Type I, Grade I, PVC compound conforming to ASTM resin specification D1785. All pipes must meet requirements as set forth in Federal Specification PS-22-70, with an appropriate standard dimension (S.D.R.) (solvent-weld pipe).
 2. PVC Non-pressure Lateral Line Piping:
 - a. Non-pressure buried lateral line piping shall be OVC class 200 with solvent-weld joints
 - b. Pipe shall be made from NSF approved, Type I, Grade II PVC compound conforming to ASTM resin specification D1784. All pipes must meet requirements set forth in federal specification PS-22-70 with an appropriate standard dimension ratio.
 3. Fittings 4" and larger shall be pushed on ductile iron designed and manufactured using ASTM A-536 Grade 70-50-05 ductile iron with tensile strength of 70,000 psi such as manufactured by Harco or approved equal.
 4. Fittings 3" and smaller shall be schedule 40, I-2, II-I NSF approved conforming to ASTM test procedure D2466 PVC solvent-weld fittings.
 5. Solvent cement and primer for PVC solvent-weld pipe and fittings shall be of type and installation methods prescribed by the manufacturer.
 6. All OVC pip must bar the following markings:
 - a. Manufacturer's name.
 - b. Nominal pipe size.
 - c. Schedule or class.
 - d. Pressure rating in P.S.I.
 - e. NSF (National Sanitation Foundation) approval.
 - f. Date of expiration.
 - g. Reclaimed water.
 7. All fittings shall bear the manufacturer's name or trademark, material designation, applicable I.P.S., schedule number and NSF seal of approval.
- D. Irrigation Lateral Line Pipe:

1. Pipes 3/4" diameter and larger: ASTM D 2231, PVC, 1120 or 1220, SDR 21.0, 200 PSI.
 2. Pipes 1/2" diameter: ASTM D 2241, PVC, 1120 or 1220, SDR 13.5, 315 PSI.
- E. Fittings for solvent welded joints
1. Schedule 40: ASTM D 2466.
 2. Schedule 80: ASTM D 2467.
- F. Fittings for threaded joints - ASTM D 2466, PVC, schedule 80.

2.03 GENERAL-DUTY VALVES

- A. Isolation valves shall have bell or spigot ends, flanges or screw joints as required for the piping in which they are installed.
- B. Isolation valves shall be manufactured of Class D cast iron or brass conforming to the AWWA Standard C-500 or Federal Specification WW-V-58, Class A. all valves must be resilient seat and shall be fitted with a 2" x 2" square wrench nut and shall be opened counter-clockwise. Stem extension shall be added to bring operating nut to within 2' of finished grade.

2.04 REMOTE CONTROL VALVES

- A. Automatic Control Valves: Bronze body, normally closed, diaphragm type with manual flow adjustment, and operated by 24-C ac solenoid.
1. All electric control valves shall be of the same manufacturer.
 2. All electric control valves shall have a manual flow adjustment and pressure regulating module.
 3. Provide and install one (1) control valve box for each electric control valve.
 4. Electric remote control valve shall be Hunter ICV-G.
 5. All selection valves shall have ball valve install upstream.
- B. Automatic Drain Valves: Spring-loaded-ball type of construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig.
- C. Quick-Couplers: Factory fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, purple rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.
1. All quick couplers shall be installed using "o-ring" style swing joint and located in 10" round valve box.

- D. Remote Control-valve Boxes: Box and cover, with open bottom and openings for piping; designed for installing flush with grade. Include sizes as required for valves and service.
 - 1. Valve boxes shall be heavy duty plastic 17" x 11-3/4" x 12" depth. Black with purple cover. Valve box shall be Series 1419, bolt cover, by Carson Industries, Inc., 1925 Street, Laverne, CA 91750, (213)732-6265, or approved equal.
 - 2. Manufacturers:
 - a. Carson Industries LLC.
 - b. Christy Concrete Products, Inc.

- E. Gate Valve and Control Wire Splice Boxes:
 - 1. Quick coupler and control wire splice boxes shall be heavy duty plastic 10" diameter x 10-1/4" depth, black with purple cover, No. 910-12B, by Carson Industries, Inc. or approved equal.
 - 2. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/8" minimum to 1" maximum.

2.05 SPRINKLERS

- A. Description: Brass or plastic housing and corrosion-resistant interior parts designed for uniform coverage over entire spray area indicated, at available water pressure.
 - 1. Manufacturers:
 - a. Hunter Industries Incorporated.
 - b. Rain Bird Sprinkler Mfg. Corp.
 - 2. Flush, Surface Sprinklers: Fixed pattern, with screw-type flow adjustment.
 - 3. Bubblers: Fixed pattern, with screw-type flow adjustment.
 - 4. Shrubbery Sprinklers: Fixed Pattern, with screw-type flow adjustment.
 - 5. Pop-up, Spray Sprinklers: Fixed pattern, with screw-type flow adjustment and stainless-steel retraction spring.
 - 6. Pop-up, Rotary, Spray Sprinklers: Gear drive, full-circle and adjustable part-circle types.
 - 7. Pop-up, Rotary, Impact Sprinklers: Impact drive, full-circle and part-circle types.
 - 8. Aboveground, Rotary, Impact Sprinklers: Impact drive, full-circle and part-circle types.

2.06 SPRINKLER SPECIALTIES

- A. Strainer/Filter Units: Brass or plastic housing, with corrosion-resistant internal parts; of size and capacity required for devices downstream from unit.
- B. Emitters: PE or vinyl body.
 - 1. Manufacturers:
 - a. Amiad Filtration Systems
 - b. Netafim USA.
 - c. Rain Bird Sprinkler Mfg. Corp.
 - 2. Single-outlet Emitters: To deliver the following flow at approximately 20 psig (138 kPa):
 - a. Flow: 1 gph.
 - b. Tubing Size: 1/8" (3mm) minimum ID and 10' long.
 - 3. Outlet Caps: Plastic, for outlets without tubing.
- C. Drip Tubes: NPS 1/2 (DN 15) NPS 3/4 (DN 20), flexible PE or PVC tubing for emitters and other devices, of length indicated and with plugged end.
 - 1. Manufacturers:
 - a. Agricultural Products, Inc.
 - b. Agrifim.
 - c. Netafim USA.
 - d. Rain Bird Sprinkler Mfg. Corp.
- D. Dripper Line:
 - 1. Dripper line shall consist of nominal sized 1/2" low density, linear polyethylene tubing, housing internal pressure compensating, continuously self-flushing, and integral drip emitters. The tubing shall have an outside diameter (O.D.) of 0.67", and an inside diameter (I.D.) of 0.57". The emitters shall have the ability to independently regulate discharge rates, with an output pressure of 7-70 psi, at a constant flow of 0.62 gph. The dripper line shall have factory install emitters 12" on center.
 - 2. Automatic line flushing valve shall be installed at the end of each independent zone. The valve shall be capable of flushing one (1) gallon of water at the beginning of each irrigation cycle.
 - 3. Pressure regulating valve shall be capable of regulating pressure from 11111115-50 psi using interchangeable, color coded regulating springs. The regulator shall have a built in indicator that shows when the proper outlet pressure has been reached.
 - 4. Disc filter shall be a multiple disc filter with color coded filter elements indicating the mesh size of the element being used. The disc shall be constructed of chemical resistant thermoplastic for corrosion.

2.07 CONTROLLER(S)

- A. Controller(s) shall be hybrid type controller(s) as specified on drawings.
 - 1. Controller shall be per the drawings or approved equal.
 - 2. The final location of the controller will be verified on-site with the owner representative and the Landscape Architect.
- B. Wiring: AWG-ULUF 600 volt with solid copper conductors and insulated cable; suitable for direct burial.
 - 1. Manufacturers:
 - a. Paige Cable, or approved equal.
 - b. Regency Wire and Cable, or approved equal.
 - 2. Feeder-circuit Cables: No. 12 AWG minimum, between building and controllers and runs over 1,000 LF.
 - 3. Low-voltage, Branch-circuit Cables: No. 14 AWWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple cable installation in same trench.
 - 4. Where more than one (1) wire is placed in a trench, the wiring shall be taped together at intervals of 10'.
 - 5. An expansion curl shall be provided within 3' of each wire connection. Expansion curl shall be of sufficient length at each splice connection at each electric control, so that in case of repair, the valve bonnet may be brought to the surface without disconnecting the control wires. Control wires shall be laid loosely in trench without stress or stretching of control wire conductors.
 - 6. All splices shall be made with Wade, DBY (Direct Bury) Splice by 3M or approved equal. Use one (1) splice per connector sealing pack. All splices must use UL approved connector.
 - 7. Field splices between the automatic controller and electrical control valves, less than 500' apart, will not be allowed without prior approval of the Architect.
 - 8. All field splices shall be installed in a 10" round valve box.

2.08 BACKFLOW PREVENTERS

- A. Double Check Assembly: Febco No. 850 (CMB Industries), P.O. Box 8070, Fresno, Ca 92747, (209)252-0791, or approved equal. Size as per drawings.

2.09 REMOTE CONTROL VALVE TIES

- A. Remote control valve ties shall be Christy's Valve I.D. tag model ID-STD-Y with wire to attach numbered tag to valve.

2.10 SOLVENT CEMENT FOR SOLVENT WELDED JOINTS

- A. Christy's Red Hot Blue Glue, Christy Enterprises, Inc. 1207 W. Struck Avenue, No. E, Orange, CA 92667, (800)258-4583, or approved equal. Use a compatible primer recommended by the solvent cement manufacturer.

2.11 SEALANT FOR THREADED JOINTS UNDER CONSTANT PRESSURE

- A. Rector Seal Liquid Teflon, Rector Seal Corp., 2830 Produce Row, Houston, TX 77023, (713)928-6423, or approved equal.

2.12 SLEEVES UNDER PAVING FOR CONTROL WIRE AND IRRIGATION LINES

- A. ASTM D 2455, PVC, schedule 40 as shown on drawings.

2.13 FITTINGS FOR THREADED JOINTS

- A. ASTM D 2466, PVC, schedule 80.

2.14 RAINFALL MONITOR

- A. Shall be Hunter Rain-Clik, or approved equal.

PART 3 EXECUTION

3.01 INSPECTION

- A. Site Conditions:
 1. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions and receive Architect's approval prior to proceeding with work under this section.
 2. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities which are caused by his operations or neglect. Check existing utilities drawings for existing utility locations.
 3. Coordinate installation of sprinkler irrigation materials including pipe, so there shall be no interference with utilities, other construction, or difficulty in planting trees, shrubs, and ground covers. Coordinate work with other site contractors.
 4. The Contractor shall carefully check all grades for satisfaction so that he may safely proceed before starting work on the sprinkler irrigation system.
 5. No machine trenching, unless approved by Architect, is to be done within drip line of trees. Trenching is done by hand, tunneling, boring, or other methods approved by Architect. It is understood that the piping layout is diagrammatic and piping shall be routed around trees and shrubs in such a manner to avoid damage to plants.

3.02 PREPARATION

- A. Physical Layout:
 - 1. Piping and head layout is shown on plans in schematic form only. All pipes to be installed directly behind curbs, walks, and walls wherever possible.
 - 2. Prior to installation, the Contractor shall stake out all pressure supply lines, routing, and location of sprinkler heads.
 - 3. All layouts shall be approved by Architect prior to installation.
- B. Water Supply:
 - 1. Sprinkler irrigation system shall be connected to water supply points of connection as indicated on the drawings.
 - 2. Connections shall be made at approximate locations as shown on drawings. Contractor is responsible for minor changes caused by actual site conditions.

3.03 EARTHWORK

- A. Refer to Division 31 section "Earth Moving" for excavating, trenching, and backfilling.
- B. Location of Heads – Design location is represented as accurately as possible. Make minor adjustments on site with approval of Landscape Architect as necessary to ensure consistent and even spacing where applicable. Set all heads minimum 6" from back of curb and 4" from edge of concrete walls.
- C. Install piping and wiring in sleeves under sidewalks, roadways, parking lots, and railroads.
- D. Drain Pockets – Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4" to 3" to 12" below grade. Cover gravel or crushed stone with sheet of asphalt saturated felt and backfill remainder with excavated material.
- E. Provide minimum cover over top of underground piping according to the following:
 - 1. Irrigation Main Piping: Minimum depth of 18" below finished grade.
 - 2. Circuit Piping: 12".
 - 3. Drain Piping: 12".
 - 4. Drip Irrigation in Turf Grass: 4" or per the drawings. See installation below.
 - 5. Drip Irrigation in Plant Beds: 2" or per the drawings. See installation below.
 - 6. Sleeves: 24".
- F. Backfill:
 - 1. The trenches shall not be backfilled until all required tests are performed. Trenches shall be carefully backfilled with the excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand, or other approved materials, free from large clods of earth or stones. Backfill shall be mechanically compacted in landscaped areas to a dry density equal to adjacent undisturbed soil in planting area. Backfill will conform to adjacent grades without dips, sunken areas, humps, or other surface irregularities.
 - 2. A fine granular material backfill will be initially placed on all lines (minimum 4" depth). No foreign matter larger than 1/2" in size will be permitted in the initial backfill.
 - 3. Where rock is encountered in trenching, 4" of sand above the pipe and 4" of sand below the pipe will be used as initial backfill.
 - 4. Flooding of trenches will be permitted only with approval of Architect.
 - 5. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn, planting, or other construction are necessary, the Contractor shall make all required adjustments without cost to the owner.
- G. Existing Lawns: Where trenching is required across existing lawns, (or in even of changes or repairs after new lawn has been established), uniformly cut strips of sod 6" wider than trench. Remove sod in rolls of suitable size for handling and keep moistened until replanted.

1. Backfill trench within 6" of finished grade and compact. Continue to fill with acceptable topsoil and compact to bring sod even with existing lawn.
2. Replant sod within two (2) days after removal, roll and water generously.
3. Re-sod and restore to original condition all of the sod in areas not in healthy condition equal to adjoining lawns 30 days after replanting.

3.04 INSTALLATION

- A. General: Unless otherwise indicated, Contractor shall comply with requirements of the governing uniform plumbing code.
- B. Pipes:
 1. Piping Mains and Laterals: Lay out sprinkler mainlines and perform line adjustments and site modifications to laterals prior to excavation. Lay pipe on solid subbase, uniformly sloped without humps or depressions.
 2. PVC Pipe Assembly:
 1. Cut PVC pipe square and de-burr. Clean pipe and fittings using primer as recommended by the PVC pipe manufacturer. Use purple tinted primer to aid in visual inspection.
 2. Apply a thin even flow coat of PVC solvent cement to inside of fitting and pipe mating surface. Cure joints as recommended by the manufacturer and keep pipe and fitting out of service during curing period. Construct watertight joints equal to or greater in strength than the pipe, do not tap pipe at fittings.
 3. Install plastic pipe in dry weather, when temperature is above 40 degrees Fahrenheit and in accordance with manufacturer's written instructions. Allow joints to cure at least 24 hours at temperature above 40 degrees Fahrenheit before testing.
 4. Plastic pipe shall be snaked in the trenches in a manner to provide for expansion and contraction as recommended by pipe manufacturer.
- C. Sleeves Under Paving: The majority of sleeves under paving are existing sleeves as shown on drawings. Where boring is required for new sleeves (refer to drawings), it shall be a "wet bore." Install sleeves 12" beyond edge of pavement. Perform trench and backfill in accordance with these specifications.
- D. Concrete Thrust Blocks:
 1. Install where the rubber-gasket irrigation main changes direction as at ells and tees and where the rubber-gasket main terminates.
 2. Pressure tests shall not be made for a period of 36-48 hours following the completion of pouring the blocks.
 3. Blocks for these mains shall be sized and placed in strict accordance with the pipe manufacturer's specifications and shall be of an adequate size and so placed as to take all the thrust created by the maximum internal water pressure.
- E. Irrigation Heads:
 1. Flush irrigation lines with full head of water and install heads after hydrostatic test is completed.
 2. Install heads at manufacturer's recommended heights.
 3. Locate part-circle heads to maintain a minimum distance of 4", 12", 24", and 48" from walls and 2" from other boundaries, unless otherwise indicated.
 4. Check for uniformity of coverage and pattern correctness. Adjust for 100% coverage where required.

5. Install nozzles with water running at reduced pressure starting with the head closest to the valve.
6. Adjust arcs and radius at normal operating pressure.
- F. Drip Irrigation: Lines shall be installed 2" below the surface of the soil to the top of the pipe when installed in plant beds and 4" below the surface of the sod or soil to the top of the pipe when installed in lawn (sod, hydromulch, sod, plugs, sprigs) or grass areas.
- G. Electric Remote Control Valves:
 1. Adjust automatic control valves to provide flow rate at rated operating pressure required for each irrigation section.
 2. Install valves in valve boxes, arranged for easy adjustment and removal. Locate valves to ensure ease of access for maintenance such that no physical interference with other elements of the project exists.
 3. All valve boxes shall be located to not be easily visible or to be in an area that is the focus of the landscape.
- H. Remote Control Valve Tags: One (1) remote control valve tag shall be attached to stem of each electric remote control valve. Tags shall be numbered sequentially. Numbers shall correspond to station numbers in electric controller. Provide tags and corresponding numbers for wires pulled for future valves.
- I. Valve Boxes: install valve boxes to cover electric remote control valves. Install one (1) valve per valve box. Top pf valve box shall be flush with finished grade. Bury minimum four (4) bricks under base of each box as support.
- J. Control Wire Splice Boxes: Install control wire splice box to cover any splice in control wire. Top of valve box shall be flush with finished grade. Bury minimum four (4) bricks under base of each box as support. Install control wire splice box to cover wires pulled for future valves.
- K. Gravel Backfill: Backfill valve boxes and control wire splice boxes with gravel, minimum 6" depth.
- L. Electric Controller:
 1. Controllers should be fully grounded.
 2. Connect remote control valves to controller in clockwise sequence to correspond with stations 1, 2, 3, successively.
 3. Affix a non-fading copy of irrigation diagram to a cabinet door below controller's name. Irrigation diagram shall be sealed between two (2) plastic sheets, 20 mils. Minimum thickness. Irrigation diagram shall show clearly all valves operated by the controller, showing station number, valve size, and type of planting irrigated.
 4. Provide galvanized padlock against vandalism. Provide two (2) keys to owner. Keys to be matched with existing controller key locking mechanisms.
 5. Power to Controller and Locations: Locations shown on plan for controllers is approximate. Final location shall be determined on site by owner. Contractor shall supply 120 VAC to controller from adjacent existing power sources. Follow local governing codes in electrical work.
 6. Lighting Protection and Grounding: Provide full grounding and lighting protection per system manufacturer's recommendations. Grounding network shall measure 10 OHMS or less when measured with a vibra-ground instrument.
- M. Irrigation Control Wires:
 1. Provide 24 volt system for control of automatic circuit-section valves of underground irrigation system. Provide unit capacity to suit number of circuits indicated.

2. Install control wires with irrigation mains and laterals in common trench where possible. Lay control wires neatly together to side of pipe. Provide looped slack at valves, corner, bores, and snake wire in trench to allow for contraction, tie wires in bundles at 10' intervals. Line splices will be allowed on runs of 500' or more. Splices shall be made and placed on control wire splice boxes.
 3. Common ground wire shall be white. No other wires shall be white.
 4. Supply two (2) extra wires, for each direction of run, to valve which is located greatest distance from controller. Extra wire shall be orange. Leave two (2) loops of wire at each valve location.
 5. Color of wire from controller to control valve shall be consistent to each valve.
 6. Solder splices and protect with splicing material specified. Provide 12" long expansion loop within 3' of each wire connection and splice on runs of wire 100' or longer.
- N. Backflow Preventers:
1. Make required connection to water supply according to local codes and manufacturer's written instructions.
 2. Install pressure type backflow devices at required grade in accordance with the local plumbing code. Exposed mainline and mainline risers above PVC pipe main elevation shall be copper. Install one (1) brass union in riser downstream of device.
 3. Insulate all above ground piping.
 4. Provide backflow certification to Landscape Architect within ten days of backflow installation and operation.

3.05 TESTING

- A. General: Notify landscape Architect 48 hours in advance when testing will be conducted. Conduct tests in presence of landscape Architect.
- B. Hydrostatic Test: Test irrigation main line, before backfilling trenches, to a hydrostatic pressure of not less than operating pressure for 6 hours. Piping may be tested in sections to expedite work. Remove and repair or replace piping and connections which do not pass hydrostatic testing.
- C. Pressure shall be maintained for a 24 hour leak test.
- D. Shut off mainline at backflow preventer during non-working hours until Contractor has demonstrated the mainline is stable.
- E. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and irrigation heads are adjusted to final position.
 1. Demonstrate to Landscape Architect that system meets coverage requirements, is a specified and indicated, and that automatic controls function properly.
 2. Coverage requirements are based on operation of one (1) circuit at a time.
 3. After completion of grading, sodding, and rolling grass areas, carefully adjust lawn sprinkler heads so they will be flush with or not more than 1/2" above finished grade. Set shrub sprinkler heads not more than 1/2" above top of mulch.

3.06 MAINTENANCE

- A. Contractor shall correctly maintain the irrigation system during the installation process and throughout the landscaping maintenance service period. Specified in Section 32 93 00 – Plants.
- B. Contractor shall provide "as-built" drawings for new work, showing dimensioned location of valves, meters, backflow preventers, controllers, and mainline. Contractor shall request reproducible Mylar from the Landscape Architect in preparation of "as-built" drawings.

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END OF SECTION 32 84 00

SECTION 329200
TURF AND GRASSES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Solid Sod.
2. Hydromulch.

B. Related Sections:

1. Retain Sections in subparagraphs below that contain requirements Contractor might expect to find in this Section but are specified in other Sections.
2. Division 31 Section "Site Clearing" for topsoil stripping and stockpiling.
3. Division 31 Section "Earth Moving" for excavation, filling and backfilling, and rough grading.
4. Division 32 Section "Planting Irrigation" for turf irrigation.
5. Division 32 Section "Plants" for border edgings.

1.03 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of topsoil.
- B. Imported Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil. Imported soils must be used if no existing on-site soils or not enough on-site soils are available.
- C. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- D. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

- E. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.
- F. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.
- G. Existing On-site soils: Salvaged and stockpiled topsoil that is tested and suitable for use in growing proposed grasses or plants. Soil must be tested and pass or be amended per the soil test. In addition to amendments and / or fertilizers the contractor shall process the soil by raking the soil until it is free of rocks larger than 1" in any direction or any other deleterious materials. Contractors shall not count on only using on-site soils. Imported soils shall be used to supplement or completely replace on-site soils. It is the contractors responsibility to estimate the amount of soil available on site.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.
 - 2. Sod & Hydromulch: Include product label and manufacturer's application instructions specific to this Project.
 - 3. Imported Topsoil: Include product label and manufacturer's application instructions specific to this Project.
- B. Product Certificates: For soil amendments and fertilizers from manufacturer.
- C. Soil: Laboratory test results clearly stating the existing on-site soils and imported soils are acceptable for turf and grass growth, and the fertilizers / amendments to add to soils to achieve an acceptable condition. Contractor will bid and supply imported topsoil. Existing onsite stockpiled topsoil will only be used if it is determined (by the architect, landscape architect and general contractor) that the existing onsite stockpiled topsoil is acceptable based upon the laboratory test result submittals, quantity of soil, and on-site inspections, by the architect / landscape architect.
 - 1. Laboratory reports from Wallace Laboratories, LLC or approved equal. (310) 615-0116.
 - 2. Texas A&M Agrilife Extension, 2478 TAMU, College Station, TX, 979-845-4816
 - 3. Provide 1 test sample and report for each 250 cubic yard, or a minimum of two samples total, if total stockpiled soil to be used is less than 500 cubic yards, of on-site stock piled top soil to be used on site. Samples to be taken from various areas in the stock piled material.
- D. Schedule of planting that includes delivery of sod and plant material to the site, layout of beds, layout of plant material, bed prep, application of herbicides, pesticides and fertilizers, planting of each bed (or areas of the site), staking, maintenance and all landscape/irrigation/site related items or events. The schedule shall also provide the

overall master construction schedule and how the landscaping fits into the master construction schedule and critical path.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Landscape Contractor shall have a permanent office located within a 50-mile radius of the project site.
- B. Pesticide Applicator: State licensed for commercial application.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants or near or under existing trees.
 - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

1.07 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.08 MAINTENANCE SERVICE

- A. Initial Turf Maintenance Service: Provide maintenance by skilled employees of Landscape Installer continuously after sod and/or hydromulch is installed and continue until final completion and acceptance by the Landscape Architect and Owner. Maintain as required in Part 3.
- B. After receipt of final completion and acceptance, Landscape Contractor shall maintain the project for an additional 60 days as part of this scope of work. Maintain as required in Part 3.
- C. Upon termination of 60-Day Maintenance period, Landscape Contractor shall notify the Landscape Architect of request for final inspection. At this time all defective work shall be corrected by Landscape Contractor and 1 year guaranty period shall begin.

PART 2 PRODUCTS

2.01 TURFGRASS SEED/SOD

- A. Turfgrass Species: State-certified seed of grass species as follows:
 - 1. Buffalo Grass – solid sod.
 - 2. Native Trail Mix – seed, by Native American Seed (1 lb per 1,000 s.f.)
 - 3. Annual Rye Grass – hydromulch *if needed.

2.02 MULCHES

- A. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- B. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.03 IMPORTED TOPSOIL

- A. Imported topsoil for sod and hydromulch lawns shall be Coleman Turf Mix as supplied by Organics by Gosh, 512/276-1211, or approved equal, with the following characteristics:
 - 1. General - Topsoil shall be free of roots, clods, stones larger than 1-inch in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush and other litter. It shall not be infested with nematodes or other undesirable disease-causing organisms such as insects and plant pathogens.
 - 2. Topsoil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil.
 - 3. Gradation limits - soil shall be a sandy loam or loam. The definition of soil texture shall be the USDA classification scheme cited below. Gravel over 2 millimeters in diameter shall be less than 20% by weight.
 - 4. Permeability Rate - Hydraulic conductivity rate shall be not less than one inch per hour nor more than 20 inches per hour when tested in accordance with the USDA Handbook Number 60, method 34b or other approved methods.
 - 5. Fertility - The range of the essential elemental concentration in soil shall be as follows for approval of source soil:

Ammonium Bicarbonate/DTPA Extraction
parts per million (mg/kilogram
dry weight basis

phosphorus	10 - 40
potassium	100 - 220
iron	5- 35
manganese	0.6 - 6
zinc	1 - 8

copper	0.3 - 5
boron	0.2 - 1
magnesium	50 - 150
sodium	0 - 100
sulfur	25 - 500
molybdenum	0.1 - 2

6. Acidity - The soil pH range measured in the saturation extract (Method 21a, USDA Handbook Number 60) shall be 6.0 - 7.9.
 - a. If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50%. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75%. No more than three metals shall be present at 50% or more of the above values
7. Salinity - The salinity range measured in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 0.5 - 2.5 dS/m.
8. Chloride - The maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 150 mg/l (parts per million)
9. Boron - The maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/l (parts per million)
10. Sodium Adsorption Ratio (SAR) - The maximum SAR shall be 3 measured per Method 20b, USDA Handbook Number 60
11. Aluminum – Available aluminum measured with the Ammonium Bicarbonate/DTPA Extraction shall be less than 3 parts per million
12. Soil Organic Matter Content - Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter. The desirable range is 3% to 6%. The carbon:nitrogen ratio should be about 10. A high carbon:nitrogen ratio can indicate the presence of hydrocarbons or non-humified organic matter.
13. Calcium Carbonate Content - Free calcium carbonate (limestone) shall not be present for acid-loving plants
14. Heavy Metals - The maximum permissible elemental concentration in the soil shall not exceed the following concentrations:

Ammonium Bicarbonate/DTPA Extraction
parts per million (mg/kilogram)
dry weight basis

arsenic	1
cadmium	1
chromium	10

cobalt	2
lead	30
mercury	1
nickel	5
selenium	3
silver	0.5
vanadium	3

15. Phytotoxic constituent, herbicides, hydrocarbons etc. - Germination and growth of monocots and dicots shall not be restricted more than 10% compared to the reference soil. Growth inhibiting constituents must not be present.

2.04 FERTILIZERS

- A. Organic fertilizers containing no artificial ingredients nor fillers nor urea or bio-solids.

1. Lady Bug All Purpose Fertilizer 8-2-4 as supplied by Lady Bug Natural Brand, 512-858-9090, 160 McGregor Land, Dripping Springs, Texas 78620. Or approved equal.

2.05 PESTICIDES / HERBICIDES

- A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the Landscape Architect and replace with new topsoil.

3.02 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
1. Protect adjacent and adjoining areas from hydromulching overspray.
 2. Protect grade stakes set by others until directed to remove them.

3.03 TURF AREA PREPARATION (BERMUDA SOD & HYDROMULCH)

- A. Limit turf subgrade preparation to areas to be planted.
1. Landscape Contractor shall be responsible for coordinating finished grade with Sitework Contractor and General Contractor. Landscape Contractor shall be responsible for placement of final 6" to topsoil so rough grades should be left 4" to 6" below desired finished grade. Should excess existing soil or fill be left by Sitework Contractor or General Contractor, Landscape Contractor shall remove excess as needed to allow for the specified depth of topsoil within the turf grass area. Legally dispose of excess soil off-site.
- B. Loosen existing subgrade to a minimum depth of 2 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Spread imported / or on-site salvaged topsoil to a minimum depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet. Contractor will bid and supply imported topsoil. Existing onsite stockpiled topsoil will only be used if it is determined (by the architect, landscape architect and general contractor) that the existing onsite stockpiled topsoil is acceptable based upon the laboratory test result submittals, quantity of soil, and on-site inspections, by the architect / landscape architect.

- D. Finish Grading: Grade turf areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation.
- E. Islands in parking lot shall have a minimum 5% slope to provide positive drainage unless grading plan specifically shows a different condition.
- F. Roll and rake, remove ridges, and fill depressions to meet finish grades. Contractor shall be responsible for providing positive drainage in all lawn areas. Limit finish grading to areas that can be planted in the immediate future.
- G. Apply Fertilizer, thoroughly and evenly incorporating it with the soil to a depth of 6 inches by discing or other approved methods.
- H. Before installing sod or hydromulch, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- I. Moisten prepared area before installing sod or hydromulch if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.04 SOLID SOD

- A. Do not lay dormant sod or install sod on saturated or frozen soil.
- B. Lay sod to form a solid mass with tightly filled joints. Butt ends and sides of sod strips. Do not overlay edges. Stagger strips to offset joints with adjacent courses. Remove excess sod. Sod shall be flush with adjacent curbs and pavement.
- C. Install initial row of sod in a straight line, beginning at bottom of slopes, perpendicular to the direction of the sloped area. Place subsequent rows parallel to the previously installed row.
- D. For slopes 3:1 or greater, stake sod/soil layers together using metal sod stakes that penetrate at least 6" into the subsoil.
- E. Water sod thoroughly with a fine spray immediately after laying.
- F. Roll with light lawn roller to ensure contact with subgrade.
- G. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.05 HYDROMULCH

- A. Hydromulch: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydromulch application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
- B. Mix slurry with tackifier.
- C. Seed Content in Hydromulch slurry shall be as follows:
 - 1. Native Trail Mix – 1 lb per 1,000 square feet

2. Annual Rye Grass – 8 lbs per 1,000 square feet. Annual rye grass to only be planted if the construction schedule dictates that turf grass be installed between October 1st and March 1^{5th}. If annual rye is installed the contractor must return in February and scalp the rye grass tight to the soil. The clippings shall be raked up and removed from the site. This must be done as many times as necessary to eradicate the rye grass and prior to installing the specified permanent turf grass.

Hydromulch all areas as indicated on plans.

- D. Hydromulch shall be applied in a uniform cover.
- E. Immediately remove and clean all hydromulch overspray from trees, shrubs, curbs, pavement, fire hydrants, light poles and other site improvements.
- F. Saturate hydromulch area with fine water spray immediately after installation. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below seed.
- G. Sod/seed.

3.06 TURF MAINTENANCE

- A. Maintain and establish turf as prescribed in Section 1 above. Maintenance shall be done on a weekly basis during the months of April through October and on a bi-weekly basis during the months of November through March.
- B. Maintenance shall include watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
 - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
 - 2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- C. Watering: Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.
- D. Mowing: Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet.

3.07 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.08 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.
- C. Contractor shall notify Owner 48 hours prior to all pesticide applications. Notification shall include place of application as well as products being applied.

3.09 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- C. Remove nondegradable erosion-control measures after grass establishment period.
- D. Repair any areas disturbed by or not vegetated under erosion control devices. Repair shall include fine grading the area, installing topsoil, hydromulching and irrigating for establishment.

END OF SECTION 32 92 00

SECTION 32 93 00 - PLANTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 specification sections, apply to this section.

1.02 SUMMARY

A. Section Includes:

1. Plant Material.
2. Fertilizers.
3. Planting soils.
4. Mulches.
5. Aggregates.
6. Pesticides.
7. Landscape Edgings.
8. Filter Fabric.
9. Tree stabilization.

B. Related Sections:

1. Division 31 section "Site Clearing" for protection of existing trees and plantings, topsoil stripping and stockpiling, and site clearing.
2. Division 31 section "Earth Moving" for excavation, filling, and rough grading and for subsurface aggregate drainage and drainage backfill materials.
3. Division 32 section "Turf and Grasses" for turf (lawn), hydroseeding, sod, and erosion-control materials.
4. Division 33 section "Subdrainage" for below-grade drainage of landscaped areas, paved areas, and wall perimeters.

1.03 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

- B. Balled-and-Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1
- C. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60. 1 for type and size of plant required.
- D. Finish Grade: Elevation of finished surface of planting soil.
- E. Planting Mix: Soil produced off-site by homogenously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- F. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- G. Pests: Living organisms that reside where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- H. Planting Area: Areas to be planted.
- I. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- J. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- K. Stem Grinding Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- L. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface or a backfill before planting soil is placed.
- M. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.
- N. Surface Soil: Soil that is present at the top layer of existing soil profile at the project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
 2. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to the project.
 3. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to the project of the actual plants that will be installed. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three (3) photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.
 4. Contractor shall submit laboratory test reports of imported topsoil and onsite stock piled soils to be used. Report shall clearly state that the imported soils are acceptable for plant growth. The report shall also state that the existing on-site soils are acceptable for plant growth or clearly list the amendment needed to achieve an acceptable condition.
 - a. Laboratory reports from Texas Plant & Soil Lab, (956)383-0739 or Wallace Laboratories, LLC (310)615-0116 or approved equal.
 - b. Provide one (1) test sample and report for each 250 cubic yard, or a minimum of two (2) samples total, if total stockpiled soil to be used is less than 500 cubic yards, of on-site stockpiled topsoil to be used on site. Samples to be taken from various areas in the stockpiled material.
- B. Samples for Verification: For each of the following:
1. Organic Mulch: 1-quart volume of mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each sample shall be typical of the lot material to be furnished; provide an accurate representation of color, texture, and organic makeup.
 2. Planting Mix: 1-quart volume of planting mix; in sealed plastic bags labeled with each composition of materials by percentage of weight and source of mulch. Each sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture.
 3. Aggregates: 1-quart volume of mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each sample shall be typical of the lot material to be furnished; provide an accurate representation of color, texture, and organic makeup.
 4. Topsoil: 1-quart volume of mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each sample shall be typical of the lot material to be furnished; provide an accurate representation of color, texture, and organic makeup.

- C. Qualification Data: Landscape Contractor shall have a permanent office located within a 50-mile radius of the project site.
- D. Schedule of planting that includes delivery of plant material to the site, layout of beds, layout of plant material, bed prep, application of herbicides, pesticides and fertilizers, planting of each bed (or areas of the site), staking, maintenance and all landscape/irrigation/site related items of events. The schedule shall also provide the overall master construction schedule and how the landscaping/irrigation will fit into the master construction schedule and critical path.
- E. The final as-builts shall be provided by the Contractor and shall be CAD generated. The Landscape Architect will provide their CAD base file for the Contractor to use as his starting point. The final CAD file provided by the Contractor shall be completely bound (xrefs) and purged.

1.05 QUALITY ASSURANCE

- A. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60. 1.
- B. Measurements: Measure according to ANSI Z60. 1. Do not prune to obtain requires sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6" above the root flare for trees up to 4" caliper size and 12" above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- C. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for a genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of root ball and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.
- D. Notify architect of sources of planting materials seven (7) days in advance of delivery to site.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.
- B. Bulk Materials:
 - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas, plants, or near or under existing trees.
 - 2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
 - 3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.
- C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape.

Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

- D. Handle planting stock by root ball or container only.
- E. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 1. Set balled stock on ground and cover ball with mulch.
 - 2. Do not remove container-grown stock from containers before time of planting.
 - 3. Water root systems of plants stored on-site deeply and thoroughly with a fine mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

1.07 PROJECT CONDITIONS

- A. Field Measurements: verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by owner or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated.
 - 1. Notify Landscape Architect, Construction Manager, and Owner no fewer than 5 working days in advance of proposed interruption of each service or utility.
 - 2. Do not proceed with interruption of services or utilities without Landscape Architect, construction manager, or owner's written permission.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.
- D. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
 - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.08 WARRANTY

- A. Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth for a warranty period of 12 months from the date of substantial completion.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plants falling or blowing over.
 - c. Faulty performance of edgings and tree grates.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Include the following remedial actions as a minimum:

- a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
- b. Replace plants that are more than 25% dead or in an unhealthy condition at the end of the warranty period.
- c. Provide extended warranty for period equal to original warranty period, for replacement plant material.
- d. Opinion of plant status by the Landscape Architect shall be final.

1.09 MAINTENANCE SERVICE

- A. Initial Maintenance Service for all Plant Material: Provide maintenance by skilled employees of Landscape Installer continuously after plants are installed and continue until final completion and acceptance by the Landscape Architect and Owner. Maintain as required in Part 3.
- B. After receipt of final completion and acceptance, Landscape Contractor shall maintain the project for an additional 60 days as part of this scope of work. Maintain as required in Part 3.
- C. Upon termination of 60 days maintenance period, Landscape Contractor shall notify the Landscape Architect of request for final inspection. At this time all defective work shall be corrected by Landscape Contractor. At the end of the 60 days maintenance service/warranty period the Landscape Contractor shall remove all stakes and guy wires.

PART 2 PRODUCTS

2.01 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in plant schedule or plant legend shown on drawings and complying with ANSI Z60. 1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf, and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two (2) branches or between branch and trunk ("included bark"); crossing trunks, cut-off limbs more than 3/4" in diameter; or with stem girdling roots will be rejected.
- C. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- D. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60. 1 for types and forms of plants required. Plants of a larger size may be used if acceptable to architect, with a proportionate increase in size of roots or balls.
- E. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at the root flare according to ANSI Z60. 1. Root flare shall be visible before planting.
- F. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on drawings.

2.02 FERTILIZERS

- A. Organic Fertilizer: Granular organic fertilizer containing no artificial ingredients, fillers, urea, or bio-solids.
 - 1. Lady Bug All Purpose Fertilizer 8-2-4 as supplied by Lady Bug Natural Brand, (512)858-9090, 160 McGregor Land, Dripping Springs, Texas 78620.

2.03 PLANTING SOILS

- A. Planting Soil Bed Mix: Backfill mix for trees, shrubs, and ground covers shall be Coleman Shrub Mix as supplied by Organics by Gosh, (512)276-1211, or approved equal.
 - 1. Physical properties as follows:
 - a. Decomposed granite 3/8 screened 10%
 - b. Organics 20-30%
 - c. Imported topsoil (low in clay, high in silt and sand) 60-70%. See below.
- B. Imported Topsoil: Supply high quality imported topsoil of loamy character, high in humus and organic content from local agricultural source. Topsoil to be free of clay, lumps, coarse sands, stones, roots, and other organic matter. There shall be no toxic amounts of acid or alkaline elements. Topsoil is to be used for on-site mixing or backfill mix. Supplier shall be Organics by Gosh or approved equal.
 - 1. General: Topsoil shall be free of roots, clods, and stones larger than 1" in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush, and other litter. It shall not be infested with nematodes or other undesirable disease-causing organisms such as insects and plant pathogens.
 - 2. Topsoil shall be friable and have sufficient structure in order to give good tilth and aeration to the soil.
 - 3. Gradation Limits: Soil shall be a sandy loam or loam. The definition of soil texture shall be the USDA classification scheme cited below. Gravel over 2 millimeters in diameter shall be less than 20% by weight.
 - 4. Permeability Rate: Hydraulic conductivity rate shall be not less than 1" per hour or more than 20" per hour when tested in accordance with the USDA Handbook Number 60, Method 34b or approved methods.
 - 5. Fertility: The range of the essential elemental concentration in soil shall be as follows for approval of source soil:

Ammonium Bicarbonate/DTPA Extraction

Parts per million (mg/kilogram)

Dry weight basis

Phosphorus 10 – 40

Potassium 100 – 220

Iron	5 – 35
Manganese	0.6 – 6
Zinc	1 -8
Copper	0.3 – 5
Boron	0.2 – 1
Magnesium	50 – 150
Sodium	0 – 100
Sulfur	25 – 500
Molybdenum	0.1 – 2

6. Acidity: The soil pH range measured in the saturation extract (Method 21a, USDA Handbook Number 60) shall be 6.0 – 7.9.
7. If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50%. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75%. No more than three (3) metals shall be present at 50% or more of the above values.
8. Salinity: The salinity range measured in the saturation extract (method 3a, USDA Handbook Number 60) shall be 0.5 – 2.5 dS/m.
9. Chloride: The maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 150 mg/l (parts per million).
10. Boron: The maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/l (parts per million).
11. Sodium Absorption Ratio (SAR): The maximum SAR shall be 3 measured per method 20b, USDA Handbook Number 60.
12. Aluminum: Available aluminum measured with the Ammonium Bicarbonate/DTPA Extraction shall be less than 3 parts per million.
13. Soil Organic Matter Content: Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter. The desirable range is 3% to 6%. The carbon:nitrogen ratio should be about 10. A high carbon:nitrogen ratio can indicate the presence of hydrocarbons or non-humified organic matter.
14. Calcium Carbonate Content: Free calcium carbonate (limestone) shall not be present for acid-loving plants.
15. Heavy Metals: The maximum permissible elemental concentration in the soil shall not exceed the following concentrations:

Ammonium Bicarbonate/DTPA Extraction

Parts per million (mg/kilogram)

Dry weight basis

Arsenic	1
Cadmium	1
Chromium	10
Cobalt	2
Lead	30
Mercury	1
Nickel	5
Selenium	3
Silver	0.5
Vanadium	3

16. Phytotoxic Constituent, Herbicides, Hydrocarbons, etc.: Germination and growth of monocots and dicots shall not be restricted more than 10% compared to the reference soil. Growth inhibiting constituents must not be present.

2.04 MULCHES

A. Shredded Hardwood: As supplied by Austin Wood Recycling, (512)259-7430, or approved equal.

2.05 AGGREGATES

A. Gravel: New Mexico River Rock, washed, as supplied by Custom Stone Supply (512)462-3363, or approved equal. Size 1"-2" diameter.

B. Decomposed Granite: Decomposed granite as supplied by Custom Stone Supply (512)462-3363 or approved equal. Size 1/4" to fine.

2.06 PESTICIDES

A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as

required for project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

- B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for weed growth that has already germinated.

2.07 LANDSCAPE EDGINGS

- A. Concrete Edging:
 - 1. 6" thick broom-finished concrete.
 - 2. 12" thick broom-finished concrete.
- B. Steel Edging:
 - 1. Steel Edging by COL-MET, (800)829-8225, or approved equal.
 - 2. Size: 1/8" x 4" deep with stakes.
 - 3. Color: Black.

2.08 FILTER FABRIC

- A. TenCate, Mirafi 140N
 - 1. Geo Solutions Inc., (512)445-0796, or approved equal.

2.09 TREE STABILIZATION

- A. Stakes and Guys:
 - 1. Tree Stakes for Shade Tree Planting: 8' length steel "T" posts – Color: Black – with plastic stake caps at each post.
 - 2. Tree Stakes for Ornamental Tree Planting: 8' length steel "T" posts – Color: Black – with plastic stake caps at each post.
 - 3. Guying: Tree-Tie Webbing by Arborbrace, or approved equal, Arborbrace – 561-628-3591, www.treestaking.com

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable level to attain required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by architect and replace with new planting soil.

3.02 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Layout individual tree and shrub locations and areas for multiple planting. Stake locations, outline areas, adjust locations when requested, and obtain Landscape Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

3.03 PLANTING AREA ESTABLISHMENT

- A. Bed Preparation:
 - 1. Excavate existing soils or fill material to the depth indicated for ground cover areas or shrub areas. Dispose of excess soils legally offsite or coordinate with civil drawings and specifications to determine if soils can be used on site.
 - 2. Remove stones larger than 1" in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off owner's property.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - 3. Install planting soil bed mix in prepared bed. Planting soil bed mix shall be installed in continuous beds – POCKET PLANTING OF SHRUBS AND GROUNDCOVERS SHALL NOT BE PERMITTED.
 - a. Groundcover Areas: Install 12" of planting soil bed mix.
 - b. Shrub Areas: Install 15" of planting soil bed mix.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise distributed after finish grading.

3.04 SHRUB AND GROUNDCOVER PLANTING

- A. Apply fertilizers per the manufacturer's recommendations to the prepared planting bed. Allow enough time between the applications of fertilizers, for safe planting of all proposed plant material.
- B. Remove all plant containers.
- C. Install plants in straight rows using triangular spacing.
- D. Use planting soil bed mix for backfill.
- E. Backfill planting bed in layers, tamping to settle soil and eliminate voids and air pockets. When the planting pit is approximately half full, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
- F. Repair settling of plants or finished grade and ensure positive drainage.

3.05 EXCAVATION FOR TREES

- A. Planting Pits for Trees: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of a bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away

- from center. Do not further disturb base, ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit.
1. Excavate approximately 2X as wide as ball diameter.
 2. Excavate perimeter of pit at least 1.5 x the depth of the root ball.
 3. Trees shall be placed so that root flare is 2" (NOTE: THIS AMOUNT CAN/MAY CHANGE DEPENDING ON PROJECT LOCATION) above adjacent finished grade. Do not excavate deeper than depth of root ball, measured from the root flare to the bottom of the root ball.
- B. Obstructions: Notify architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
1. All rock in planting beds or pits shall be removed to twice the specified depth (2X the size shown and specified). Where location changes for plant materials are requested, notify Landscape Architect of requested change at least 48 hours prior to need. In the event that locations cannot be adjusted, rock removal will be necessary and shall be the responsibility of the Landscape Contractor.
- C. Drainage:
1. Fill excavations with water and allow to percolate away before positioning trees and shrubs.
 2. Notify architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

3.06 TREE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60. 1. If root flare is not visible, remove soil in a level manner from the root ball to where the top most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Apply fertilizers per the manufacturer's recommendations to the tree planting pit. Allow enough time between the application of fertilizers, for safe planting of all propose plant material.
- C. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- D. Set trees plumb and in center of planting pit with root flare 2 above finish grades.
1. Use planting soil bed mix for backfill.
 2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls, remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken or during planting operation.
 3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately 1/2 filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 4. Place planting tablets in each planting pit when pit is approximately 1/2 filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1" from root tips; do not place tablets in bottom of hole.
 5. Continue backfilling process. Water again after placing and tamping final layer of soil.

- E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.
- F. Install tree stabilization per manufacturer's recommendations or per details shown on drawings.

3.07 TREE, SHRUB, AND GROUND COVER PRUNING

- A. Prune thin and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; prune to retain natural character.
- B. Apply pruning paint to wounds immediately.

3.08 PLANTING AREA MULCHING

- A. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees in Turf Areas: Apply mulch ring of 3" depth. Do not place mulch within 6" of trunks or stems.
 - 2. Mulch in Planting Areas: Apply 3" average depth of shredded hardwood mulch over whole surface of planting area, and finish level with adjacent finish grades.

3.09 PLANT MAINTENANCE

- A. Maintain plantings as prescribed in Section 1 above. Maintenance shall be done on a weekly basis during the months of April through October and on bi-weekly basis during the months of November through March.
- B. Maintenance shall include pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- C. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- D. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.10 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with owner's operations and others in proximity to the work. Notify owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Non-Selective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written recommendations. Do not apply to seeded areas.
- C. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already germinated weeds and in accordance with manufacturer's written recommendations.

- D. Contractor shall notify owner 48 hours prior to all pesticide applications. Notification shall include place of application as well as products being applied.

3.11 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After installation, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and project site.

3.12 DISPOSAL

- A. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off owner's property.

3.13 EXPIRATION OF GUARANTEE PERIOD

- A. Landscape Contractor shall notify Owner or Landscape Architect in writing, 30 days prior to the expiration of the 1-year guarantee period. A site inspection will be made by the owner or Landscape Architect to verify that all work and materials are in good and healthy condition. All work and materials that are determined by the Landscape architect to be unacceptable or dead shall be replaced at the Landscape Contractor's expense. Upon completion of replacement of all unacceptable work or dead materials, the Landscape Architect will notify the Owner of the guarantee expiration.

END OF SECTION 32 93 00

ITEM NO. 201S SUBGRADE PREPARATION 8-20-07

201S.1 Description

This item shall govern scarifying; blading and rolling the subgrade to obtain a uniform texture and provide as nearly as practicable a uniform density for the top 6 inches (150 mm) of the subgrade.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

201S.2 Submittals

The submittal requirements of this specification item may include:

- A. A plan identifying classification and characteristics (P.I., optimum moisture-density, etc.) of insitu subgrade soils, as well as the source, classification and characteristics of any proposed borrow material,
- B. Type and size of equipment proposed to produce the required compaction, and
- C. Compaction (moisture-density, etc) test results for in-situ subgrade soils and/or borrow materials.

201S.3 Construction Methods

Prior to initiation of subgrade preparation activities, all operations involving Standard Specification Item No. 101S, "Preparing Right of Way" and/or Standard Specification Item No. 102S, "Clearing and Grubbing" shall be completed. The surface of the subgrade shall be scarified and shaped in conformity with the typical sections and the lines and grades indicated on the Drawings; by the removal of existing material or addition of approved material as established by the Engineer or designated representative. Any deviation in the subgrade cross section which exceeds ½ inch in a length of 10 feet (12 mm in a length of 3 meters), measured longitudinally, shall be corrected by loosening, adding or removing material, and then reshaping and compacting by sprinkling and rolling.

All unsuitable material shall be removed and replaced with approved material. All foundations, walls or other objectionable material shall be removed in accordance with Standard Specification Item No. 104S, "Removing Portland Cement Concrete" to a minimum depth of 18 inches (450 mm) under all structures and 12 inches (300 mm) under areas to be vegetated. All holes, ruts and depressions shall be filled with approved material and compacted by approved methods.

The subgrade shall be prepared sufficiently in advance to insure satisfactory prosecution of the Work. The Contractor will be required to set blue tops for the subgrade on the centerline, at the quarter points and along the curb lines or edge of pavement at maximum intervals of 50 feet (15 meters). The subgrade shall be tested by proof rolling in conformity with Standard Specification Item No. 236S, "Proof Rolling" prior to placement of the first course of base material. Any unstable or spongy subgrade areas identified by proof rolling shall be corrected either by additional re-working, drying and compaction, or by removal and replacement of unsuitable materials. When specifically directed by the Engineer or designated representative, the Contractor shall re-work the subgrade* as follows:

- A. Remove the unstable subgrade to the full depth of the unstable insitu material or to a minimum depth of 6 inches (150 mm), whichever is greater;
- B. Spread the material over a sufficient area to allow reworking of the excavated material;

- C. Disc, scarify or otherwise breakup the excavated material and allow to dry (Note: If approved by the Engineer or designated representative, the addition of lime or other additive may be used to aid in the drying process or to stabilize the unstable material);
- D. Fill the excavated area with the re-worked material and compact to specified densities; and
- E. Proof roll the re-worked area.
- * The Rework process will not be allowed for unstable organic subgrade soils. These type soils will be permanently removed and replaced with materials approved by the Engineer or designated representative.

All suitable material removed in accordance with Standard Specification Item No, 111S, "Excavation", may be utilized in the subgrade with the approval of the Engineer or designated representative. All other material required for completion of the Subgrade, including those defined in accordance with Specification Item No. 130S, "Borrow", shall also be subject to approval by the Engineer or designated representative.

It is the intent of this specification to provide the required density and moisture control for the subgrade based on the plasticity characteristics of the approved materials. The subgrade materials shall be sprinkled as required and compacted to the extent necessary to provide the density specified below, unless otherwise indicated on the Drawings. The Plasticity Index (P.I.) will be established in accordance with TxDOT Test Methods Tex-104-E, Tex-105-E and Tex-106-E. The density determination will be made in accordance with TxDOT Test Method Tex-114-E and field density measurements will be made in accordance with TxDOT Test Method Tex-115-E.

Description	Density, Percent	Moisture
Non-swelling Soils (P.I. less than 20)	Not less than 95	
Swelling Soils (P.I. between 20 and 35)	Not less than 95 nor more than 102	Not less than optimum
Swelling Soils (P.I. greater than 35)	Not less than 95 nor more than 100	Not less than optimum

Subgrade materials on which planting or turf will be established shall be compacted to a minimum of 85 percent of the density as determined in accordance with TxDOT Test Method Tex-114-E. Field tests for density in accordance with TxDOT Test Method Tex-115-E will be made as soon as possible after compaction operations are completed. If the material fails to meet the density specified, it shall be reworked as necessary to obtain the density required.

Prior to placement of any base materials, the in-place density and moisture content of the top 6 inches (150 mm) of compacted subgrade shall be checked. If the tests indicate that the relative density and moisture do not meet the limits specified in the table above, the subgrade shall be reworked as necessary to obtain the specified compaction and moisture content. All initial testing will be paid for by the City of Austin. All retesting shall be paid for by the Contractor.

201S.4 Measurement

All acceptable subgrade preparation when included in the contract as a separate pay item, will be measured by the square yard (square meter: 1 square meter equals 1.196 Square yards). The measured area includes the entire width of the roadway for the entire length as indicated on the Drawings.

201S.5 Payment

The work and materials presented herein will generally not be paid for directly, but shall be included in the unit price bid for the item of construction in which this item is used when specified as a separate pay item in the contract bid form, subgrade preparation shall be measured as specified above and paid for at the contract unit bid price for "Subgrade Preparation". The bid price shall include full compensation for all work herein specified,

including the furnishing of all materials, equipment, tools and labor and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

Pay Item No. 201S:	Subgrade Preparation	Per Square Yard.
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End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 201S, "SUBGRADE PREPARATION"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Portland Cement Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 130S	Borrow
Item No. 236S	Proof Rolling
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-114-E	Laboratory Compaction Characteristics & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils & Base Materials

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 201S, "SUBGRADE PREPARATION"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No.132S	Embankment
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 112	Subgrade Widening
Item No. 132	Embankment
Item No. 150	Blading
Item No. 158	Specialized Excavation Work
Item No. 204	Sprinkling

Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)
Texas Department of Transportation: <u>Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials

ITEM NO. 210S FLEXIBLE BASE 2-24-10

210S.1 Description

This item governs furnishing and placing a crushed stone base course for surfacing, pavement, or other base courses. "Flexible Base" shall be constructed on an approved, prepared surface in one or more courses conforming to the typical sections and to the lines and grades, indicated on the Drawings or established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

210S.2 Submittals

The submittal requirements of this specification item may include:

- A. Source, gradation and test results for the crushed limestone material,
- B. Notification that the crushed limestone stockpile is completed and ready for testing, and
- C. Field density test results for in-place compacted flexible base,

210S.3 Material

- A. Mineral Aggregate

The material shall be crushed argillaceous limestone meeting the requirements specified herein. The material shall be from sources approved by the City and shall consist of durable crushed stone that has been screened to the required gradation.

Flexible base materials shall be tested according to the following TxDOT standard test methods:

a) Preparation for Soil Constants and Sieve Analysis	Tex-101-E
b) Liquid Limit	Tex-104-E
c) Plastic Limit	Tex-105-E
d) Plasticity Index	Tex-106-E
e) Sieve Analysis	Tex-110-E
f) Wet Ball Mill	Tex-116-E
g) Triaxial Test	Tex-117-E, Part II

- 1. Plasticity Index shall be determined in accordance with Tex-107-E (Linear Shrinkage) when liquid limit is unattainable as defined in Tex-104-E.
- 2. When a soundness value is required on the drawings, the material shall be tested in accordance with Tex-411-A.

Base material shall be stockpiled after crushing, then tested by the City's designated laboratory and approved by the Engineer or designated representative prior to being hauled to the Project.

The material shall be well graded and shall meet the following requirements:

Sieve Designation	Other Requirements	% Retained	
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US	SI			
1¾"	45 mm		0	
¾"	22.4 mm		10—35	
¾'	9.5 mm		30—50	
#4	4.75 mm		45—65	
#40	425 µm		70—85	
		Maximum Plasticity Index		10
		Maximum Wet Ball Mill		42
Maximum Increase in passing #40 (425 µm) sieve from Wet Ball Mill Test			20	

Minimum compressive strength when subjected to the triaxial test shall be 35 psi at 0 psi lateral pressure [240 kiloPascal (kPa) at 0 kPa lateral pressure] and 175 psi at 15 psi lateral pressure [1200 kiloPascal (kPa) at 100 kPa lateral pressure].

B. Asphaltic Material

Prime Coat. Prime Coat shall conform to the requirements of Standard Specification Item 306S, "Prime Coat", except for measurement and payment.

210S.4 Stockpiling, Storage and Management

A. Managing Material:

The stockpile shall be constructed on a relatively smooth area that has been cleared of debris, weeds, brush, trees and grass. Stockpiles shall contain between 25,000 and 50,000 cubic yards (19,100 to 38,200 cubic meters). The stockpile shall be constructed using scrapers, bottom dumps or other similar equipment that allows dumping and spreading without rehandling. The stockpile shall be constructed to allow dumping and spreading in one direction only. The height of the stockpile shall not exceed the capabilities of available equipment to make a full cut (bottom to top) on any of the four sides.

A stockpile shall be completed before being tested by the City. The Contractor's supplier shall notify the City when a stockpile has been completed and is ready to be tested. The stockpile shall not be added to after it has been tested.

The Contractor shall provide material only from stockpiles that have been inspected, tested and accepted by the City. A ticket showing the date, source, stockpile number, and net weight (mass) shall be provided to the Inspector with each load of material delivered to the Project.

Material shall be loaded from the stockpile by making successive vertical cuts through its entire depth.

B. Test Sampling:

The Contractor's supplier may choose the method of sample gathering for testing by the City's laboratory as follows:

1. The supplier shall make a full-height cut a sufficient distance into each side of the stockpile to obtain a uniform sample. The four samples (one from each side of the stockpile) shall then be combined and mixed into a single "test" specimen from which the City's laboratory can obtain a sample.
2. As the stockpile is constructed, a perpendicular cut will be made across the spreading direction at every two feet to four feet (0.6 to 1.2 meters) of height and the sample used to start a "mini" stockpile. The process shall be repeated in two feet to four feet (0.6 to 1.2 meter) increments of height, until the stockpile and the "mini" stockpile are completed. Samples shall be obtained from the "mini" stockpile in the same manner described in (1) above.

C. Testing and Acceptance:

When initial tests indicate that the material is unacceptable, the City may, if requested by the Contractor's supplier, sample and test the material one more time. The additional sampling and testing shall be paid for by the supplier.

210S.5 Construction Methods

A. Preparation of Subgrade:

Flexible base shall not be placed until the Contractor has verified by proof rolling that the subgrade has been prepared and compacted in conformity with Standard Specification Item 201S, "Subgrade Preparation," to the typical sections, lines and grades indicated on the Drawings. Any deviation shall be corrected and proof rolled prior to placement of the flexible base material.

The Contractor shall not place flexible base until the subgrade has cured to the satisfaction of the Engineer or designated representative, regardless of whether or not the subgrade has been successfully proof rolled. As a minimum, this will be after the surface displays no damp spots and there is no evidence of "sponginess" in the subgrade.

B. First Lift:

Immediately before placing the flexible base material, the subgrade shall be checked for conformity with grade and section. The thickness of each lift of flexible base shall be equal increments of the total base depth. No single lift shall be more than six inches (150 mm) or less than three inches (75 mm) compacted thickness.

The material shall be delivered in approved vehicles. It shall be the responsibility of the Contractor to deliver the required amount of material. If it becomes evident that insufficient material was placed, additional material as necessary shall be delivered and the entire course scarified, mixed and compacted.

Material deposited upon the subgrade shall be spread and shaped the same day unless otherwise approved by the Engineer or designated representative. In the event inclement weather or other unforeseen circumstances render spreading of the material impractical, the material shall be spread as soon as conditions allow.

Additionally, if the material cannot be spread and worked the same day it is deposited, the Contractor shall "close up" the dump piles before leaving the job site. "Closed up" shall be defined as the use of a motor grader to blade all dump piles together, leaving no open space between piles.

The material shall be spread, sprinkled, if required, then thoroughly mixed; bladed, dragged and shaped to conform to the typical sections indicated on the Drawings.

All areas and "nests" of segregated coarse or fine material shall be corrected or removed and replaced with well-graded material.

Each lift shall be sprinkled as required to bring the material to optimum moisture content, then compacted to the extent necessary to provide not less than the percent density specified in Section 210S.5.D, "Density." In addition to the requirements specified for density, the full depth of flexible base material shall be compacted to the extent necessary to remain firm and stable under construction equipment. After each section of flexible base material is completed, tests, as necessary, will be made by the Engineer or designated representative. As a minimum, three in-place density tests per section per day will be taken. If the material fails to meet the density requirements, it shall be reworked as necessary to meet these requirements. All initial testing will be paid for by the City. All retesting shall be paid for by the Contractor.

Throughout the entire operation, the surface of the material shall be maintained by blading and, upon completion, shall be smooth and shall conform to the typical section indicated on the Drawings and to the established lines and grades.

In that area on which pavement is to be placed, any deviation in excess of 1/4 inch (6.5 mm) in cross section or 1/4 inch in a length of 16 feet (6.5 mm in a length of 5 meters) measured longitudinally shall be corrected by loosening, adding or removing material, and by reshaping and recompacting. All irregularities, depressions or weak spots shall be corrected immediately by scarifying the areas affected, adding suitable material as required, and by reshaping and recompacting. Should the lift, due to any reason or cause, lose the required stability, density and/or finish before the surfacing is complete, it shall be recompacted and refinished at the Contractor's expense.

C. Succeeding Lifts:

Construction methods for succeeding lifts shall be the same as prescribed for the first lift. For that lift of the flexible base upon which the curb and gutter will be constructed, as well as the last flexible base lift (i.e. top of the flexible base), the Contractor shall check the surface of the lift for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet (15 meters) on the centerline, at quarterpoints, at curb lines or edge of pavement, and at other points that may be indicated on the Drawings.

When the thickness of a particular lift of the flexible base is in question, the Contractor shall check the surface of the lift for conformity to the lines and grades by setting "blue tops" at intervals not exceeding 50 feet (15 meters) on the centerline, at quarter points, at curb lines or edge of pavement, and at other points that may be indicated on the Drawings

D. Density:

The flexible base shall be compacted to not less than 100 percent density as determined by TxDOT Test Method Tex-113-E.

Field density determination shall be made in accordance with TxDOT Test Method Tex-115-E unless otherwise approved by the Engineer or designated representative. Each lift of the flexible base shall also be tested by proof rolling in conformity with Standard Specification Item 236S "Proof Rolling."

E. Priming:

After the flexible base material has been compacted to not less than 100 percent density, and tested by proof rolling, a prime coat will be applied in accordance with Standard Specification Item 306S, "Prime Coat."

F. Curing:

Pavement materials, such as a tack coat or surface course, shall not be placed on the primed surface until the prime coat has been absorbed into the base course. At least 24 hours, or longer if designated by the Engineer or designated representative, shall be allowed when cutback asphalt is used as the prime coat.

210S.6 Measurement

"Flexible Base" will be measured by the cubic yard (cubic meter: 1 cubic meter equals 1.196 cubic yards), complete in place, as indicated in the Contract Documents.

210S.7 Payment

This item will be paid for at the contract unit bid price for "Flexible Base". The unit bid price shall include full compensation for all work specified herein, including the furnishing, hauling, placing and compacting of all materials; for rolling, proof rolling, recompacting and refinishing; for all water required; for retesting as necessary; for priming; and for all equipment, tools, labor and incidentals necessary to complete the Work.

Prime coat will not be measured nor paid for directly but shall be included in the unit price bid for Standard Specification Item 210S, "Flexible Base."

Payment will be made under one of the following:

Pay Item No. 210S-A:	Flexible Base	Per Cubic Yard.
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End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 210S, "Flexible Base"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 201S	Subgrade Preparation
Item No. 236S	Proof Rolling
Item No. 306S	Prime Coat
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Tex-101-E	Preparation of Soil and Flexible Base Materials for Testing
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic Limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-107-A	Determination of Bar Linear Shrinkage of Soils
Tex-110-E	Determination of Particle Size Analysis of Soils
Tex-113-E	Laboratory Compaction Characteristics and Moisture-Density Relationship of Base Materials and Cohesionless Sands
Tex-115-E	Field Method for Determination of In-Place Density of Soils and Base Materials
Tex-116-E	Ball Mill Method for Determination of the Disintegration of Flexible Base Material
Tex-117-E	Triaxial Compression Tests for Disturbed Soils and Base Materials
Tex-411-A	Soundness of Aggregate By Use of Sodium Sulfate or Magnesium Sulfate

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 210S, "Flexible Base"</u>	
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 1000S-2	Flexible Base with Asphalt Surface Trench Repair-Existing Pavement
No. 510S-3	Typical Trench with Paved Surface
No. 1000S	Bus Stop Paving
No. 1000S-10	Local Street Sections
No. 1000S-11(1)	Residential and City of Austin Neighborhood Collector Street Sections
No. 1000S-11(2)	Industrial and Commercial Collector Street Sections
No. 1000S-12(1)	Primary Collector Street Sections
No. 1000S-12(2)	Primary Arterial Street Sections
No. 1000S-13(1)	Minor Arterial Street Sections (4 Lanes)
No. 1000S-13(2)	Minor Arterial Street Sections-(4 Lanes divided)

No. 1000S-14	Major Arterial Street Sections
<u>City of Austin Utility Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 5.8.2	Flexible Base
Section 5.7.3	Flexible Base with Asphalt Surface
Section 5.9.1	Excavation in Alley
<u>City of Austin Transportation Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 3.2.0	General Criteria
Section 3.4.3.D	Layer Data-Minimum Thickness
Table 3-1	Minimum Layer Thickness
Section 3.4.3.F	Layer Data- Minimum Thickness
Table 3-2	Layer Thickness Increment
Section 3.4.3.J	Layer Data-Stiffness Coefficient
Table 3-3	Stiffness Coefficient
Table 3-9	Recommended Salvage values
Table 3-10	AASHTO Layer Coefficients

ITEM NO. 220S SPRINKLING FOR DUST CONTROL 2-24-10

220S.1 Description

This item shall govern the authorized application of water for dust control on specified streets, detours, haul routes or construction sites, as shown on the Drawings or directed by the Engineer or designated representative, for the purpose of maintaining these areas relatively free of dust.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

220S.2 Submittals

The submittal requirements of this specification item include

- A. The manufacturer, model and description of the proposed dust control equipment,
- B. The sprinkling plan including application rate, pattern of sprinkling and scheduled times of application.

220S.3 Materials

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

220S.4 Construction Methods

Dust control shall only be conducted when directed by the Engineer or designated representative. The Contractor shall furnish and operate an approved sprinkler, equipped with positive and rapidly working cut-off valves and approved spray bars to insure the distribution of water in a uniform and controllable rate of application over the entire width sprinkled. The Contractor shall apply the water in the quantity specified on the Drawings or as directed by the Engineer or designated representative.

It shall be the Contractor's continuous responsibility at all times, including nights, holidays and weekends until acceptance of the project by the City, to maintain the specified areas relatively free of dust in a manner that will cause the least inconvenience to the public.

220S.5 Measurement

Sprinkling for dust control will be included in the unit price bid for other items of the contract unless included as a separate pay item in the contract. When included for payment in the contract as a separate contract pay item, it will be measured in units of 1,000 gallons (3.785 kiloliters) actually placed as authorized by the Engineer or designated representative.

220S.6 Payment

When this item is specified on the Drawings as a separate pay item, the water furnished and the work performed as prescribed by this item and measured as provided under Section 220S.5, "Measurement" will be paid for in accordance with the contract unit bid price for 'Sprinkling for Dust Control'. The unit bid price shall include total compensation for all labor, materials, tools, machinery, equipment and incidentals necessary to complete the work as indicated on the Drawings.

Payment, when specified in the contract, will be made under the following:

Pay Item No. 220S-A:	Sprinkling for Dust Control (Water) -	Per 1000 gallon Unit.
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End

RELATED CROSS REFERENCE MATERIALS	
<u>Specification 220S, "Sprinkling For Dust Control"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 201S	Subgrade Preparation
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 204	Sprinkling

ITEM NO. 230S ROLLING (FLAT WHEEL) 8-20-07

230S.1 Description

This item shall govern compaction of subgrade, embankment, flexible base, surface treatments and asphalt surfaces by the operation of approved power rollers as herein specified and as directed by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

230S.2 Submittals

The submittal requirements of this specification item may include:

- A. A plan describing the condition of each roller proposed for the work, as well as the type, size, weight, configuration (three wheel, tandem, etc) for each individual roller, and
- B. The operating speed proposed for each individual roller.

230S.3 Equipment

A. Embankments and Flexible Bases

Power rollers shall be of the 3-wheel, self-propelled type, weighing not less than 10 tons (9 megagrams) and shall provide compression on the rear wheels of not less than 325 pounds per linear inch (5.80 kilograms per linear millimeter) of wheel width. All wheels shall be flat. The rear wheels shall have a diameter of not less than 48 inches (1.2 meters) and each shall have a wheel width of not less than 20 inches (510 millimeters).

B. Surface Treatments and Pavements

Power rollers shall be the 3-wheel or tandem, self-propelled type, weighing not less than 3 tons (2.7 megagrams) nor more than 6 tons (5.4 megagrams). All wheels shall be flat. Rollers shall be equipped with an adequate scraping or cleaning device on each wheel. Rollers used to compact asphalt mixture shall be equipped with a water system, which will keep all tires uniformly wet.

In lieu of the rolling equipment specified, the Contractor may, upon written permission from the Engineer or designated representative, operate other compacting equipment that will produce equivalent relative compaction in the same period of time as the specified equipment. If the substituted compaction equipment fails to produce the desired compaction within the same period of time as would be expected of the specified equipment, as determined by the Engineer or designated representative, its use shall be discontinued and the Contractor will be required to furnish the specified equipment.

Rollers shall be maintained in good repair and operating condition and shall be approved by the Engineer or designated representative.

230S.4 Construction Methods

This work shall only be conducted at the direction of the Engineer or designated representative. A sufficient number of rollers shall be provided to compact the material in a satisfactory manner. When operations are isolated and a single roller unit cannot produce the required compaction satisfactorily, additional roller units shall be provided.

A. Subgrades, Embankments and Flexible Base

The subgrade, embankment layer or base course shall be sprinkled, if required by Standard Specification Item Nos. 201S, "Subgrade Preparation" and 210S, "Flexible Base". Rolling with a power roller shall start longitudinally at the sides of the designated area and proceed towards the center, overlapping on successive trips by at least 1/2 the width of the rear wheel of the power roller. On superelevated curves, rolling shall begin at the low sides and progress toward the high sides. Alternate trips of the roller shall be slightly different in length. Rolling shall be conducted in accordance with Standard Specification Item Nos. 201S, "Subgrade Preparation" and 210S, "Flexible Base". The rollers, unless otherwise directed by the Engineer or designated representative, shall be operated at a speed between 2 and 3 miles (3 and 5 kilometers) per hour.

B. Surface Treatments and Pavements

Rolling shall be done as called for in the surface treatment (Items 310S and 320S) and asphalt pavement (Item 340S) Standard Specification Items. The sequence of work shall be as specified above for embankment layer or base course. The operating speed shall be determined by the Contractor and approved by the Engineer or designated representative.

230S.5 Measurement and Payment

Compensation will not be allowed for materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

End

SPECIFIC CROSS REFERENCE MATERIALS	
Specification 230S, "ROLLING (FLATWHEEL)"	
City of Austin Standard Specifications	
<u>Designation</u>	<u>Description</u>
Item No. 201S	Subgrade Preparation
Item No. 210S	Flexible Base
Item No. 310S	Emulsified Asphalt Treatment
Item No. 320S	Two Course Surface Treatment
Item No. 340S	Hot Mix Asphaltic Concrete Pavement

RELATED CROSS REFERENCE MATERIALS	
Specification 230S, "ROLLING (FLATWHEEL)"	
City of Austin Standard Specifications	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Portland Cement Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 130S	Borrow
Item No. 132S	Embankment
Item No. 202S	Hydrated Lime and Lime Slurry
Item No. 203S	Lime Treatment for Materials in Place
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 236S	Proof Rolling

Item No. 301S	Asphalts, Oils and Emulsions
Item No. 306S	Prime Coat
Item No. 307S	Tack Coat
Item No. 402S	Controlled Low Strength Material
Item No. 403S	Concrete for Structures
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 1000S-10	Local Street Sections
No. 1000S-11(1)	Residential and City of Austin Neighborhood Collector Street Sections
No. 1000S-11(2)	Industrial and Commercial Collector Street Sections
No. 1000S-12(1)	Primary Collector Street Sections
No. 1000S-12(2)	Primary Arterial Street Sections
No. 1000S-13(1)	Minor Arterial Street Sections (4 Lanes)
No. 1000S-13(2)	Minor Arterial Street Sections- (4 Lanes divided)
No. 1000S-14	Major Arterial Street Sections
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-Way
Item No. 110	Excavation
Item No. 112	Subgrade Widening
Item No. 132	Embankment
Item No. 150	Blading
Item No. 158	Specialized Excavation Work
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 264	Lime and Lime Slurry
Item No. 300	Asphalts, Oils and Emulsions
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 301	Asphalt Anti-stripping Agents
Item No. 310	Prime Coat (Cutback Asphaltic Materials)
Item No. 314	Emulsified Asphalt Treatment
Item No. 316	Surface Treatments
Item No. 345	Asphalt Stabilized Base (Plant Mixed)
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-101-E	Surveying and Sampling Soils for Highways
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic limit of Soils

Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-114-E	Laboratory Compaction Characteristics & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils & Base Materials
Tex-117-E	Triaxial Compression Tests for Disturbed Soils and Base Materials
Tex-120-E	Soil Cement Testing
Tex-121-E	Soil Lime Testing
Tex-126-E	Molding, Testing and Evaluation of Bituminous Black Base
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-210-F	Determination of Asphalt Content of Bituminous Mixtures by Extraction
Tex-222-F	Method of Sampling Bituminous Mixtures
Tex-228-F	Determination of Asphalt Content of Bituminous Mixtures By The Nuclear Method
Tex-600-J	Sampling and Testing of Hydrated Lime, Quicklime & Commercial Lime Slurry

ITEM NO. 236S PROOF ROLLING 8-20-07

236S.1 Description

This item shall govern furnishing and operating heavy pneumatic tired compaction equipment for locating unstable areas of embankment, subgrade and flexible base courses.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

236S.2 Submittals

The submittal requirements of this specification item may include:

- A. A plan describing the condition of each roller proposed for the work, as well as the type of traction (self propelled or drawn), Type of roller, size, weight, tire pressure (if appropriate) and configuration of each individual roller, and
- B. The operating speed proposed for each individual roller.

236S.3 Equipment

- A. Standard Proof Roller:

The proof rolling equipment shall have a loading platform or body suitable for ballast loading that is supported on a minimum of two (2) axles with not more than two (2) pneumatic tired wheels per axle. All wheels shall be arranged so that they will carry approximately equal loads when operating on uneven surfaces. Pneumatic proof rolling equipment with multiple pivotal axles and more than two tires along the front or rear axle axis shall have articulating axle supports to equally distribute the load to all tires over uneven surfaces.

The proof roller unit, under working conditions, shall have a minimum contact width of 7½ feet (2.3 meters) and shall be so designed that the gross roller weight may be varied uniformly from 25 tons to 50 tons (23 megagrams to 45 megagrams) by ballast loading. The tires shall be capable of operating under various loads with variable air pressures up to 145 psi (up to 1000 kiloPascals). The tires shall be smooth tread and shall impart a minimum ground contact pressure of 75 pounds per square inch (520 kiloPascals). Tires shall be practically full of liquid (i.e. when liquid will flow from the valve stem of a fully inflated tire with the stem in the uppermost position). The operating load and tire pressure shall be within the range of the manufacturer's chart as directed by the Engineer or designated representative.

The proof roller shall be drawn by a power train of adequate tractive effort or may be of a self-propelled type. The proof rolling equipment shall be equipped with a reverse mode transmission or be capable of turning 180 degrees in the street width. When a separate power train is used to draw the proof roller, the power train weight shall not be considered in the weight of the proof roller. The power train shall be rubber-tired when rolling subgrade and base materials. A cleated or track-type power train may be used on earth and rock embankments.

- B. Alternate Equipment:

With the written approval of the Engineer or designated representative, the Contractor may utilize alternate equipment on embankment courses, subgrade and base courses subject to the requirements of the standard proof roller except with respect to minimum contact width, axle/tire arrangement and tire tread.

Alternate equipment for stability testing of embankments shall be restricted to equipment that can be shown to impart a stress distribution on the embankment structure equivalent to or greater than the stress induced by the concentrated weight of a standard proof roller.

C. Equipment Submittals:

All standard proof rollers and proposed alternate equipment must be approved by the Engineer or designated representative prior to their use. The Contractor shall furnish the Engineer or designated representative with charts or tabulations showing the contact areas and contact pressures for the full range of tire inflation pressures and for the full range of loadings for the particular tires furnished.

Alternate equipment submittals for proof rolling of embankments shall be signed and sealed by a registered Professional Engineer licensed in the State of Texas.

236S.4 Construction Methods

A. General:

Within the ranges set forth in Section 236S.3, the load and tire inflation pressures shall be adjusted as directed by the Engineer or designated representative. It is proposed to use a contact pressure corresponding as nearly as practical to the maximum supporting value of the earthwork or base. The entirety of prepared surfaces to be tested by this method shall be proof rolled by a minimum of two passes of the proof roller tires. Each succeeding trip of the proof roller shall be offset by not greater than one tire width.

When alternate equipment is proposed and only one axle meets minimum requirements, only the qualifying axle shall be used to proof roll. If the operation of the proof roller shows an area to be unstable, the substandard area shall be brought to satisfactory stability and uniformity by additional curing, compaction, or by removal and replacement of unsuitable materials. The re-worked area shall then be proof rolled.

Proof rollers shall be operated at speeds between 2 and 6 miles per hour (3 and 10 kilometers per hour) or as directed by the Engineer or designated representative.

Acceptable limits of elastic and plastic deformation of prepared subgrade courses shall be established by proof rolling Test Sections of representative soil conditions, previously tested and approved for density and moisture requirements of the governing subgrade and earth embankment items. Proof rolling of first course base over a plastic subgrade may be waived by the Engineer or designated representative if it is determined that the prepared first course base will be damaged by the proof roller.

B. Roadway Construction:

The subgrade and all lifts of base material shall be proof rolled in new roadway construction and in the reconstruction of existing streets. Proof rolling of the curb course base shall be substituted for proof rolling of final course base at the direction of the Engineer or designated representative. Proof rolling may be waived by the Engineer or designated representative where construction is limited to turn lanes, street widening less than 7½ feet (2.3 meters) in width, or where the site is otherwise congested.

C. Trenches:

Trenches shall be proof rolled where no limitations to the operation of the proof roller exist as may be determined by the Engineer subject to the provisions hereunder.

All trenches shall be proof rolled in new roadways or in existing roadways under reconstruction. Trenches shall be proof rolled at the street subgrade elevation by longitudinal and perpendicular passes of the roller as may be dictated by the width of the trench.

Proof rolling of trenches in existing paved streets shall be limited to pavement cross-sections capable of sustaining the weight of the proof rolling equipment without imparting damage to the remaining pavement

structure as determined by the Engineer. Trenches less than 4 feet (1.2 meters) in width shall be exempted of all proof rolling requirements. Only the final course base shall be proof rolled in trenches 4 feet (1.2 meters) or wider but narrower than the proof roller contact width. The subgrade, the first course and the final course base shall be proof rolled in trenches 7½ feet (2.3 meters) or wider.

D. Embankment Construction:

All embankment courses shall be proof rolled, unless otherwise directed by the Engineer or designated representative.

If required by the Engineer or designated representative, stability testing of embankments constructed to the finished cross-section and elevation or to interim elevations shall either be conducted with a standard proof roller or alternate equipment, which can be proven to impart a horizontal and vertical pressure distributions equivalent to or greater than those induced by a standard proof roller.

236S.5 Measurement and Payment

No direct payment will be made for the materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

End

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 236S, "Proof Rolling"</u>	
<u>City of Austin Contract Documents</u>	
<u>Designation</u>	<u>Description</u>
Section 00700	General Conditions
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 130S	Borrow
Item No. 132S	Embankment
Item No. 201S	Subgrade Preparation
Item No. 202S	Hydrated Lime and Lime Slurry
Item No. 203S	Lime Treatment for Materials in Place
Item No. 204S	Portland Cement Treatment For Materials in Place
Item No. 206S	Asphalt Stabilized Base (Plant Mix)
Item No. 210S	Flexible Base
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 234S	Rolling (Tamping)
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 306S	Prime Coat
Item No. 307S	Tack Coat
Item No. 310S	Emulsified Asphalt Treatment
Item No. 320S	Two Course Surface Treatment
Item No. 340S	Hot Mix Asphaltic Concrete Pavement

Item No. 402S	Controlled Low Strength Material
Item No. 403S	Concrete for Structures
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 1000S-10	Local Street Sections
No. 1000S-11(1)	Residential and City of Austin Neighborhood Collector Street Sections
No. 1000S-11(2)	Industrial and Commercial Collector Street Sections
No. 1000S-12(1)	Primary Collector Street Sections
No. 1000S-12(2)	Primary Arterial Street Sections
No. 1000S-13(1)	Minor Arterial Street Sections (4 Lanes)
No. 1000S-13(2)	Minor Arterial Street Sections- (4 Lanes divided)
No. 1000S-14	Major Arterial Street Sections
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 112	Subgrade Widening
Item No. 132	Embankment
Item No. 150	Blading
Item No. 158	Specialized Excavation Work
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)
Item No. 264	Lime and Lime Slurry
Item No. 300	Asphalts, Oils and Emulsions
Item No. 301	Asphalt Anti-stripping Agents
Item No. 310	Prime Coat (Cutback Asphaltic Materials)
Item No. 314	Emulsified Asphalt Treatment
Item No. 316	Surface Treatments
Item No. 345	Asphalt Stabilized Base (Plant Mixed)
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-101-E	Surveying and Sampling Soils for Highways
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils
Tex-114-E	Laboratory Compaction Characteristics & Moisture Density Relationship of Subgrade & Embankment Soil
Tex-115-E	Field Method for Determination of In-Place Density of Soils & Base Materials
Tex-117-E	Triaxial Compression Tests for Disturbed Soil and Base Materials
Tex-120-E	Soil Cement Testing

Tex-121-E	Soil Lime Testing
Tex-126-E	Molding, Testing and Evaluation of Bituminous Black Base Materials
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-210-F	Determination of Asphalt Content of Bituminous Mixtures
Tex-600-J	Sampling and Testing of Hydrated Lime, Quicklime & Commercial Lime Slurry

ITEM NO. 301S ASPHALTS, OILS, AND EMULSIONS 8-20-07

301S.1 Description

This item includes the requirements for cutback asphalts, emulsified asphalts, polymer modified asphalt cements, performance graded asphalt binders and other miscellaneous asphaltic materials and latex additives.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses.

301S.2 Submittals

Submittals shall include test results for each the materials described herein when specifically identified on the drawings and/or referenced in associated standard specification items and standard details.

Submittals may include samples of the base asphalt cement and polymer additives.

301S.3 Materials

When tested in accordance with designated TxDOT, AASHTO and/or ASTM test methods, the various materials shall meet the applicable requirements of this specification.

A. Acronyms

The acronyms used in this specification are defined in the following table.

Table 1: Acronyms

Acronym	Definition	Acronym	Definition
Test Method Prefix		Polymer Modifier	
Tex	TxDOT	SBR or L	Styrene-Butadiene Rubber (Latex)
T	AASHTO	SBS	Styrene-Butadiene-Styrene Block Copolymer
D	ASTM	TR	Tire Rubber, from ambient temperature grinding of truck and passenger tires
		P	Polymer Modified
AC	Asphalt Cement	SS	Slow Setting
RC	Rapid Curing	H-suffix	Harder Residue (Lower Penetration)
MC	Medium Curing	AE	Asphalt Emulsion
SCM	Special Cutback Material	S-suffix	Stockpile Usage
HF	High Float	AE-P	Asphalt Emulsion Prime
C	Cationic	EAP&T	Emulsified Asphalt Prime and Tack
RS	Rapid Setting	PCE	Prime, Cure, and Erosion Control
MS	Medium Setting	PG	Performance Grade

B. Asphalt Cement

The material shall be homogeneous, free from water, shall not foam when heated to 350°F (177°C) and shall meet the requirements in Table 2.

Table 2: Asphalt Cement Requirements

Viscosity Grade		AC-10		AC-20		AC-30	
Property	Test Method	Min	Max	Min	Max	Min	Max
Viscosity: 140°F, poises (60°C, pascals)	T 202	800 (80)	1200 (120)	1600 (160)	2400 (240)	2400 (240)	3600 (360)
Viscosity: 275°F, stokes (135°C, pascals)	T 202	1.9 (.19)	-	2.5 (.25)	-	3.0 (.30)	-
Penetration: 77°F (25°C), 100g, 5s	T 49	85	-	55	-	45	-
Flash Point, C.O.C. °F (°C)	T 48	450 (232)	-	450 (232)	-	450 (232)	-
% Solubility trichloroethylene	T44	99.0	-	99.0	-	99.0	-
Spot test	Tex 509-C						

Viscosity: 140°F stokes (60°C pascals)	T 202	-	3000 (300)	-	6000 (600)	-	9000 (900)
Ductility 77°F (25°C), 5 cm/min, cm	T 202	100	-	70	-	50	-

C. Polymer Modified Asphalt Cement

Polymer modified asphalt cement must be smooth, homogeneous, and shall comply with the requirements listed in Table 3.

Table 3: Polymer Modified Asphalt Cement Requirements

Polymer Modified Viscosity Grade		AC-5		AC-10		AC-15P		AC-45P*	
Polymer Type		SBR		SBR		SBS		SBS	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max
Polymer in % (solids basis)	Tex-533-C	2.0	-	2.0	-	3.0	-	3.0	-
Viscosity									
140°F, poise (60°C, pascals)	T 202	700 (70)	-	1300 (130)	-	1500 (150)	-	4500 (450)	-
275°F, poise (135°C, pascals)	T 202	-	7.0 (0.7)	-	8.0 (0.8)	-	8.0 (0.8)	14.0 (1.4)	-
Penetration, 77°F (25°C), 100 g, 5 s.	T 49	120	-	80	-	100	150	50	74
Ductility, 5cm/min., 39.2°F, cm	T 51	70	-	60	-	-	-	15	-
Elastic Recovery, 50°F (10°C), %	Tex-539-C	-	-	-	-	55	-	-	-
Polymer Separation, 48 hrs**.	Tex-540-C	None		None		None		None	
Flash Point, C.O.C., °F (°C),	T 48	425 (218)	-	425 (218)	-	425 (218)	-	425 (218)	-
Tests on Residue from Thin Film Oven Test: (T179)									
Retained Penetration Ratio, 77°F (25°C), % original	T 49	-	-	-	-	0.60	1.00	0.60	0.90

* The SBS block copolymer may be pre-blended with a polymer processing oil (up to a 1:1 ratio of polymer to oil) to aid the solution of the polymer in the asphalt.

** A 350-gram (0.77 pound) sample of the asphalt-SBS blend is stored for 48 hours at 325°F (163°C). Upon completion of the storage time, the sample is visually examined for separation of the SBS from the asphalt (smoothness and homogeneity). If a question still exists about the separation of the SBS, samples shall be taken from the top and bottom of the sample for Infrared Spectroscopy analysis. A difference of 0.4% or more in the concentration of the SBS between the top and bottom samples shall constitute separation.

D. Cutback Asphalt

Cutback asphalt shall meet the requirements presented in Tables 4 and 5 for the specified type and grade.

Table 4: Rapid Curing Type Cutback Asphalt Requirements

Type-Grade		RC-250		RC-800		RC-3000	
Properties	Test Method	Min	Max	Min	Max	Min	Max

Water, percent	T55	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F (°C)	T79	80 (27)	-	80 (27)	-	80 (27)	-
Kinematic viscosity @ 140°F, cst (60°C, mm ² /s)	T201	250	400	800	1600	3000	6000
Distillation Test:	T78						
Distillate, % by volume of total distillate to 680°F (360°C):							
to 437°F (225°C):		40	75	35	70	20	55
to 500°F (260°C):		65	90	55	85	45	75
to 600°F (316°C):		85	-	80	-	70	-
Residue from Distillation, Volume %		70	-	75	-	82	-
Tests of Distillation Residue:							
Penetration, 100g, 5 sec., 77°F (25°C), cm	T49	80	120	80	120	80	120
Ductility, 5 cm/min., 77°F, 5 cm/min., cm (25°C, 50 mm/min., mm)	T51	100	-	100	-	100	-
Solubility in trichloroethylene, %	T44	99.0	-	99.0	-	99.0	-
Spot Test	Tex 509-C	ALL NEGATIVE					

Table 5: Medium Curing Type Cutback Asphalt Requirements

Type		MC-30		MC-70		MC-250		MC-800		MC-3000	
Properties	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Water, %	T55	-	0.2	-	0.2	-	0.2	-	0.2	-	0.2
Flash Point, T.O.C., °F (°C)	T79	100 (38)	-	100 (38)	-	150 (65)	-	150 (65)	-	150 (65)	-
Kinematic viscosity. @ 140°F. cst (60°C, mm ² /s)	T201	30	60	70	140	250	500	800	1600	3000	6000
Distillation Test:	T78										
Distillate, as % by volume to total distillate to 680°F(360°C):, shall be as follows:											
to 437°F (225°C):		-	25	-	20	-	10	-	-	-	-
to 500°F (260°C):		40	70	20	60	15	55	-	35	-	15
to 600°F (316°C):		75	93	65	90	60	87	45	80	15	≥75
Residue from 80°F (225°C) distillation											
Volume Percent		50	-	55	-	67	-	75	-	80	-
Tests on Distillation Residue:											
Penetration @77°F (25°C), 100g, s, 01 mm:	T49	120	250	120	250	120	250	120	250	120	250
Ductility @ 77°F, 5 cm/min, cms	T51	100*	-	100*	-	100*	-	100*	-	100*	-

(25°C, 50 mm/min., mm)		1000*	-	1000*	-	1000*	-	1000*	-	1000*	-
% Solubility in trichloroethylene	T44	99.0	-	99.0	-	99.0	-	99.0	-	99.0	-
Spot Test	Tex 509-C	ALL NEGATIVE									

* If penetration of residue is more than 200 and the ductility at 77°F (25°C) is less than 100 cm (1000 mm), the material will be acceptable if its ductility at 60°F (16°C) is more than 100cm (1000 mm).

E. Emulsified Asphalt

The material shall be homogenous. It shall show no separation of asphalt after thorough mixing and shall meet the requirements for the specified type and grade presented in Tables 6, 7 and 8.

Table 6: Anionic Emulsion Requirements

	Type	Medium Setting		Slow Setting			
		MS-2		SS-1		SS-1h	
Property	Test Method	Min	Max	Min	Max	Min	Max
Furol Viscosity @ 77°F (25°C), sec.	T72	-	-	20	100	30	100
@ 122°F(50°C), sec		100	300	-	-	-	-
Sieve Test, %.	T59	-	0.1	-	0.1	-	0.1
Miscibility (Standard Test)	T59	-	-	Passing		Passing	
Cement Mixing, %	T59	-	-	-	2.0	-	2.0
% Demulsibility: 35 cc 0.02N CaCl ₂	T59	-	30	-	-	-	-
Storage Stability 1 day, %	T59	-	1	-	1	-	1
Freezing Test, 3 Cycles*	T59	Passing		Passing	Passing		
Distillation Test	T59						
Distillation Residue, %		65	-	60			
Distillate Oil Portion, %		-	½	-	½	-	½
Tests of Residue from Distillation:							
Penetration @ 77°F (25°C), 100g, 5s	T49	120	160	120	160	70	100
Solubility in Trichloroethylene, %	T44	97.5	-	97.5	-	97.5	-
Ductility @ 77F, 5 cm/min., cm	T51	100	-	100	-	80	-
(@ 25°C, 50 mm/min., mm)		1000	-	1000	-	800	-

* Applies only when Engineer or designated representative specifies the material for winter use.

Table 7: High Float anionic Emulsion Requirements

	Type	Rapid Setting		Medium Setting	
		HFRS-2		AES-300	
Property	Test Method	Min	Max	Min	Max
Viscosity, Saybolt Furol	T72				

@ 77°F (25°C), sec.		-	-	75	400
@ 122°F (50°C), sec.		150	400	-	-
Oil Portion of Distillate, %	T59	-	2	-	7
Sieve Test, %	T59	-	0.1	-	0.1
Particle Charge	T59	positive		positive	
Coating Ability and Water Resistance:	T59				
Coating, dry aggregate		-	-	good	
Coating, after spraying		-	-	fair	
Coating, wet aggregate				fair	
Coating, after spraying				fair	
% Demulsibility: 35 ml 0.02 N CaCl ₂	T59	50	-	-	-
Storage Stability Test, 1 day, %	T59	-	1	-	1
Distillation Test	T59				
Residue by Distillation, % by weight		65	-	65	-
Oil Distillate, by volume of emulsion, %		-	1/2	-	5
Tests on Residue from Distillation:					
Penetration at 77°F (25°C), 100g, 5s	T49	100	140	300	-
Solubility in Trichloroethylene, %	T44	97.5	-	97.5	-
Ductility @ 77°F., 5 cm/min, cms	T51	100	-	-	-
(25°C., 50 mm/min, mm)		(1000)			
Float Test at 140°F (60°C), sec.	Tex 509-C	1200	-	1200	-

Table 8: Cationic Emulsion Requirements

	Type	Rapid Setting				Medium Setting				Slow Setting			
		CRS-2		CRS-2h		CMS-2		CMS-2s		CSS-1		CSS-1h	
Property	Test Method	Min	Max	Min	Max	Min.	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T72												
@ 77°F (25°C), sec.		-	-	-	-	-	-	-	-	20	100	20	100
@ 122°F (50°C), sec.		150	400	150	400	100	300	100	300	-	-	-	-
Storage stability test, 1 day %	T59	-	1	-	1	-	1	-	1	-	1	-	1
% Demulsibility: *, **	T59	40	-	40	-	-	-	-	-	-	-	-	-
Coating, ability & water resistance	T59												
Coating, dry aggregate		-	-	-	-	good		good		-	-	-	-
Coating, after spraying		-	-	-	-	fair		fair		-	-	-	-
Coating, wet aggregate		-	-	-	-	fair		fair		-	-	-	-
Coating, after spraying		-	-	-	-	fair		fair		-	-	-	-
Particle charge test	T59	Positive		Positive		Positive		Positive		Positive		Positive	
Sieve test, %	T59	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-	0.10

Cement Mixing test, %	T59	-	-	-	-	-	-	-	-	-	2.0	-	2.0
Distillation Test:	T59												
% Oil distillate, vol. of emulsion		-	1/2	-	1/2	-	7	-	5	-	1/2	-	1/2
Residue by Distillation,% by wt.		65	-	65	-	65	-	65	-	60	-	60	-
Tests on Residue from Distillation:													
Penetration, 77°F	T49	120	160	80	110	120	200	300	-	120	160	80	110
(25°C), 100g, 5s.													
Ductility,	T51												
77°F, 5 cm/min, cm		100	-	80	-	100	-	-	-	100	-	80	-
(25°C, 50 mm/min, mm)		1000	-	800	-	1000	-	-	-	1000	-	800	-
% Solubility in trichloroethylene	T44	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-	97.5	-

* At a level of 35 ml 0.8% sodium dioctyl sulfosuccinate.

** The demulsibility test shall be made within 30 days from date of shipment.

F. Polymer Modified Emulsions

The material shall be homogenous. It shall show no separation of asphalt after thorough mixing and shall meet the requirements for the specified type and grade presented in Tables 9 and 10.

G. Specialty Emulsions

Specialty emulsions may be either asphaltic-based or resin-based and must meet the requirements included in Table 11.

H. Recycling Agent

Recycling agent and emulsified recycling agent must meet the requirements of Table 12. Additionally, recycling agent and residue from emulsified recycling agent, when added in the specified proportions to the recycled asphalt, must meet the properties specified on the drawings.

Table 9: Polymer Modified Emulsified Asphalt Requirements

Type-Grade	Test Method	Rapid Setting				Medium Setting						Slow Setting	
		RS-1P		HFRS-2P		AES-150P		AES-300P		AES-300S		SS-1P	
Property	Test Method	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72												
77°F, sec.		-	-	-	-	75	400	75	400	75	400	30	100
122°F, sec.		50	200	150	400	-	-	-	-	-	-	-	-
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1	-	0.1
Miscibility	T 59	-		-		-		-		-		pass	

Coating Ability and Water Resistance:	T 59												
dry aggregate/after spray		-		-		good/fair		good/fair		good/fair		-	
wet aggregate/after spray		-		-		fair/fair		fair/fair		fair/fair		-	
Demulsibility, 35 ml of 0.02 N CaCl ₂ , %	T 59	60	-	50	-	-	-	-	-	-	-	-	-
Storage Stability, 1 day, %	T 59	-	1	-	1	-	1	-	1	-	1	-	1
Breaking Index, g	Tex-542-C	-	80	-	-	-	-	-	-	-	-	-	-
Distillation Test: ¹	T 59												
Residue by Distillation, % by wt.		65	-	65	-	65	-	65	-	65	-	60	-
Oil Distillate, % by vol of emulsion		-	3	-	0.5	-	3	-	5	-	7	-	0.5
Tests: Residue from Distillation:													
Polymer Content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	-	-	-	-	-	-	3.0	-
Penetration, 77°F, (25°C) 100 g, 5 sec.	T 49	225	300	90	140	150	300	300	-	300	-	100	140
Solubility in Trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-	97.0	-
Viscosity, 140°F, poise 60°C, Pa-s	T 202	-	-	1500	-	-	-	-	-	-	-	1300	-
Float Test, 140°F, sec.	T 50	-	-	1200	-	1200	-	1200	-	1200	-	-	-
Ductility ² ,													
39.2°F, 5 cm/min., cm	T 51	-	-	50	-	-	-	-	-	-	-	50	-
(4°C, 5 cm/min., mm)		-	-	500	-	-	-	-	-	-	-	500	-
Elastic Recovery ² , 50°F,(10°C), %	Tex-539-C	55	-	55	-	-	-	-	-	-	-	-	-
Tests on RTFO Curing of Distillation Residue:	Tex-541-C												

Elastic Recovery, 50°F,(10°F) %	Tex-539-C	-	-	-	-	50	-	50	-	30	-	-	-
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¹ Exception to AASHTO T 59: Bring the temperature on the lower thermometer slowly to 350°F +/- 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 +/- 5 min. from the first application of heat.

² HFRS-2P must meet one of either the Ductility or Elastic Recovery.

Table 10: Polymer Modified Cationic Emulsified Asphalt Requirements

Type-Grade	Test Method	Rapid Setting				Slow Setting	
		CRS-1P		CRS-2P		CSS-1P	
Property	Test Method	Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72	-	-	-	-	20	100
77°F (25°C), sec.		50	150	150	400	-	-
122°F (50°C), sec.		-	0.1	-	0.1	-	0.1
Sieve Test, %	T 59	60	-	70	-	-	-
Demulsibility, 35 ml of 0.8% sodium dioctyl sulfosuccinate, %	T 59	-	1				
Storage Stability, 1 day, %	T 59	-	1	-	1	-	1
Breaking Index, g	Tex-542-C		80	-	-	-	-
Particle Charge	T 59	positive		positive		positive	
Distillation Test: ¹	T 59	65	-	65	-	62	-
Residue by Distillation, % by wt.							
Oil Distillate, % by volume of emulsion		-	3	-	0.5	-	0.5
Tests on Residue from Distillation:							
Polymer Content, wt. % (solids basis)	Tex-533-C	-	-	3.0	-	3.0	-
Penetration, 77°F (25°C), 100 g, 5 sec.	T 49	225	300	90	150	55	90
Viscosity, 140°F, poise (60°C, Pa-s)	T 202	-	-	1300	-	-	-
Solubility in Trichloroethylene, %	T 44	97.0	-	97.0	-	97.0	-
Softening Point, °F	T 53	-	-	-	-	135	-
Ductility, 77°F, 5 cm/min., cm (25°C, 5 cm/min., mm)	T 51	-	-	-	-	70	-
Ductility ² , 39.2°F, 5 cm/min., cm (4°C, 5 cm/min., mm)	T 51	-	-	50	-	-	-
Elastic Recovery ² , 50°F (10°C), %	Tex-539-C	45	-	55	-	-	-

¹ Exception to AASHTO T 59: Bring the temperature on the lower thermometer slowly to 350°F +/- 10°F. Maintain at this temperature for 20 min. Complete total distillation in 60 +/- 5 min. from the first application of heat.

² CRS-2P must meet one of either the Ductility or Elastic Recovery.

Table 11: Specialty Emulsion Requirements

Type-Grade	Medium Setting	Slow Setting
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Property	Test Method	AE-P		EAP&T		PCE ¹	
		Min	Max	Min	Max	Min	Max
Viscosity, Saybolt Furol	T 72						
77°F (25°C), sec.		-	-	-	-	10	100
122°F (50°C), sec.		15	150	-	-	-	-
Sieve Test, %	T 59	-	0.1	-	0.1	-	0.1
Miscibility ²	T 59	-		pass		pass	
Demulsibility, 35 ml of 0.10 N CaCl ₂ , %	T 59	-	70	-	-	-	-
Storage Stability, 1 day, %	T 59	-	1	-	1	-	-
Particle Size ³ , % by volume ≤ 2.5 m	Tex-238-F	-	-	90	-	-	-
Asphalt Emulsion Distillation to 500°F (260°C) followed by Cutback Asphalt Distillation of Residue to 680°F (360°C):	T 59 & T 78						
Residue after both Distillations, % by wt.		40	-	-	-	-	-
Total Oil Distillate from both distillations, % by volume of emulsion		25	40	-	-	-	-
Distillation:	T 59						
Residue by Distillation, % by wt.		-	-	60	-	-	-
Evaporation: ⁴	T 59						
Residue by Evaporation, % by wt.		-	-	-	-	60	-
Tests on Residue after all Distillation(s):							
Viscosity, 140°F, poise (60°C, Pa-s)	T 202	-	-	800	-	-	-
Kinematic Viscosity, 140°F, cSt (60°C, mm ² /s)	T 201	-	-	-	-	100	350
Flash Point, C.O.C., °F (°C)	T 48	-	-	-	-	400 204	-
Solubility in Trichloroethylene, %	T 44	97.5	-	-	-	-	-
Float Test, 122°F (50°C), sec	T 50	50	200	-	-	-	-

¹ Supply with each shipment of PCE:

- a) a copy of a lab report from an approved analytical lab, signed by a lab official, indicating the PCE formulation does not meet any characteristics of a Resource Conservation Recovery Act (RCRA) hazardous waste;
- b) a certification from the producer that the formulation supplied does not differ from the one tested and that no listed RCRA hazardous wastes or PCB's have been mixed with the product; and
- c) a Materials Safety Data Sheet.

² Exception to AASHTO T 59: In dilution, use 350 ml of distilled or deionized water and a 1000-ml beaker.

³ Tex-238-F, beginning at "Particle Size Analysis by Laser Diffraction," "Procedure" (using - medium: distilled or deionized water and dispersant: none), or other approved method.

⁴ Exception to AASHTO T 59: Leave sample in the oven until foaming ceases, then cool and weigh.

Table 12: Recycling Agent and Emulsified Recycling Agent Requirements

Property	Test Method	Recycling Agent		Emulsified Recycling Agent	
		Min	Max	Min	Max
Viscosity, Saybolt Furol, 77°F, sec.	T 72	-	-	15	100
Sieve Test, %	T 59	-	-	-	0.1
Miscibility ¹	T 59	-		No Coagulation	
Evaporation Test: ²	T 59				
Residue by Evaporation, % by wt.		-	-	60	-
Tests on Recycling Agent or Residue from Evaporation:					
Flash Point, C.O.C., °F	T 48	400	-	400	-
Kinematic Viscosity,	T 201				
140°F, cSt		75	200	75	200
275°F, cSt		-	10.0	-	10.0

¹ Exception to AASHTO T 59: Use 0.02 N CaCl₂ solution in place of water.

² Exception to AASHTO T 59: Maintain sample at 300°F until foaming ceases, then cool and weigh.

I. Crack Sealer

This section sets forth the requirements for a polymer modified emulsion suitable for sealing fine cracks, and a rubber asphalt compound suitable for sealing cracks of 1/8 inch (3 mm) or greater width.

1. Polymer Modified Asphalt Emulsion Crack Sealer

For cracks on the order of 1/8 inch (3 mm) width, HFRS-2P polymer modified emulsion as described in the table included in Section F, Polymer Modified Emulsions of this item may be used. Requirements for the polymer modified emulsion and rubber-asphalt crack-sealing compound are presented in Table 13.

Table 13: Polymer Modified Asphalt Emulsion Crack Sealer Requirements

Property	Test Methods	Min	Max
Rotational Viscosity, 77°F, cP	ASTM D 2196, Method A	10,000	25,000
Sieve Test, %	T 59	-	0.1
Storage Stability, 1 day, %	T 59	-	1
Evaporation	Tex-543-C		
Residue by Evaporation, % by wt.		65	-
Tests on Residue from Evaporation:			
Penetration, 77°F, 100 g, 5 sec.	T 49	35	75
Softening Point, °F	T 53	140	-
Ductility, 39.2°F, 5 cm/min., cm	T 51	100	-

2. Rubber-Asphalt Crack Sealing Compound

This specification item may be a proprietary product. The compound shall be capable of being melted and applied at a temperature of 400°F (200°C) or less by a suitable oil jacketed kettle equipped with a pressure pump, a hose and a nozzle. It shall contain no water or highly-volatile matter. It shall not be tracked by vehicular traffic once it cools to road pavement temperature.

The rubber-asphalt crack sealing compound shall meet requirements in Table 14.

Table 14: Rubber-Asphalt Crack Sealer Requirements

Property	Test Methods	Class A		Class B	
		Min	Max	Min	Max
CRM Content, Grade A or B, % by wt.	Tex-544-C	22	26	-	-
CRM Content, Grade B, % by wt.	Tex-544-C	-	-	13	17
Virgin Rubber Content ¹ , % by wt.		-	-	2	-
Flash Point ² , COC, °F	T 48	400	-	400	-
Penetration ³ , 77°F, 150g, 5 sec.	T 49	30	50	30	50
Penetration ³ , 32°F, 200g, 60 sec.	T 49	12	-	12	-
Softening Point, °F	T 53	-	-	170	-
Bond ⁴ , 3 cycles, 20°F	Tex-525-C	-	Pass		

¹ Provide certification that the min. % virgin-rubber was added.

² Before passing the test flame over the cup, agitate the sealing compound with a $\frac{3}{8}$ to $\frac{1}{2}$ in. (9.5 to 12.7 mm) wide, square-end metal spatula in a manner so as to bring the material on the bottom of the cup to the surface, i.e., turn the material over. Start at one side of the thermometer, move around to the other, and then return to the starting point using 8 to 10 rapid circular strokes. Accomplish agitation in 3 to 4 sec. Pass the test flame over the cup immediately after stirring is completed.

³ Exception to AASHTO T 49: Substitute the cone specified in ASTM D 217 for the penetration needle.

⁴ No crack in the crack sealing materials or break in the bond between the sealer and the mortar blocks over $\frac{1}{4}$ in. deep for any specimen after completion of the test.

a. Properties of Rubber Used in Sealer. The rubber shall be one of the following types;

- 1) Type I - Ground tire rubber.
- 2) Type II - A mixture of ground tire rubber and high natural reclaimed scrap rubber. The natural rubber content, determined by ASTM D 297, shall be a minimum of 25 percent.

b. Ground Rubber. The ground rubber shall comply with the following gradation requirements when tested by TxDOT Test Method Tex-200-F, Part I.

Table 15: Ground Rubber Gradation Requirements

Sieve Size		Percent Retained	
U.S.	SI	Type I	Type II
No. 8	2.36 mm	0	-
No. 10	2.00 mm	0-5	0
No. 30	600mm	90-100	50-70
No. 50	300mm	95-100	70-95
No. 100	150mm	-	95-100

The ground rubber shall be free from fabric, wire, cord or other contaminating materials.

-
- c. Packaging. The rubber-asphalt crack sealing compound shall be packaged in boxes, which contain two 30-35 pound (14-16 kilogram) blocks that are individually packaged in a liner made of polyethylene, or other packaging approved by the Engineer or designated representative.

J. Performance Graded Binders

Performance graded binders must be smooth, homogeneous, show no separation when tested in accordance with Test Method Tex-540-C, and must meet the requirements in the following table.

Separation testing is not required if:

- a modifier is introduced separately at the mix plant either by injection in the asphalt line or mixer, or
- the binder is blended on site in continuously agitated tanks, or
- binder acceptance is based on field samples taken from an in-line sampling port at the hot mix plant after the addition of modifiers.

Table 16: Performance Graded Binder Requirements (Printer-friendly version in PDF)

Performance Grade	PG 58			PG 64				PG 70				PG 76				PG 82		
	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28	-34	-16	-22	-28
Average 7-day Max Pavement Design Temperature, °C ¹	58			64				70				76				82		
Min Pavement Design Temperature, °C ¹	≥-22	≥-28	≥-34	≥-16	≥-22	≥-28	≥-34	≥-16	≥-22	≥-28	≥-34	≥-16	≥-22	≥-28	≥-34	≥-16	≥-22	≥-28
ORIGINAL BINDER																		
Flash Point, AASHTO T 48: Min,	230°C																	
Viscosity, AASHTO TP 48: ^{2,3} Max, 3.0 Pas, Test Temperature,	135°C																	
Dynamic Shear, AASHTO TP 5: ⁴ G*/sin (δ), Min, 1.00 kPa Test Temperature @ 10 ead/sec.,	58°C			64°C				70°C				76°C				82°C		
Elastic Recovery, ASTM D 6084, 50°F, % Min	-	-	30	-	-	30	50	-	30	50	60	30	50	60	70	50	60	70
ROLLING THIN FILM OVEN (Tex-541-C)																		
Mass Loss, Max, %	1.0																	
Dynamic Shear, AASHTO TP 5: G*/sin (δ) in, 2.20 kPa Test Temperature @10 rad/sec.,	58°C			64°C				70°C				76°C				82°C		
PRESSURE AGING VESSEL (PAV) RESIDUE (AASHTO PP 1)																		
PAV Aging Temperature	100°C																	
Dynamic Shear, AASHTO TP 5: G*/sin (δ) Max, 5000 kPa Test Temperature 10 rad/sec., °C	25	22	19	28	25	22	19	28	25	22	19	28	25	22	19	28	25	22
Creep Stiffness, AASHTO TP 1: ^{5,6} S, Max, 300 mPa, M - value, Min, 0.300 Test Temperature @ 60 sec., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18
Direct Tension, AASHTO TP 3: ⁶ Failure Strain, Min, 1.0% Test Temperature @1.0 mm/min., °C	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18	-24	-6	-12	-18

-
- ¹ Pavement temperatures are estimated from air temperatures using an algorithm contained in the PGEXCEL3.xls software program, may be provided by the Department or by following the procedures as outlined in AASHTO MP 2 and PP 28.
 - ² This requirement may be waived at the Department's discretion if the supplier warrants that the asphalt binder can be adequately pumped, mixed and compacted at temperatures that meet all applicable safety, environmental, and constructability requirements. At test temperatures where the binder is a Newtonian fluid, any suitable standard means of viscosity measurement may be used, including capillary (AASHTO T 201 or T 202) or rotational viscometry (AASHTO TP 48).
 - ³ Viscosity at 135°C is an indicator of mixing and compaction temperatures that can be expected in the lab and field. High values may indicate high mixing and compaction temperatures. Additionally, significant variation can occur from batch to batch. Contractors should be aware that variation could significantly impact their mixing and compaction operations. Contractors are therefore responsible for addressing any constructability issues that may arise.
 - ⁴ For quality control of unmodified asphalt binder production, measurement of the viscosity of the original asphalt binder may be substituted for dynamic shear measurements of $G^*/\sin(\delta)$ at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary (AASHTO T 201 or T 202) or rotational viscometry (AASHTO TP 48).
 - ⁵ Silicone beam molds, as described in AASHTO TP 1-93, are acceptable for use.
 - ⁶ If creep stiffness is below 300 mPa, direct tension test is not required. If creep stiffness is between 300 and 600 mPa, the direct tension failure strain requirement can be used instead of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

301S.4 Equipment.

All equipment necessary to transport, store, sample, heat, apply, and incorporate asphalts, oils and emulsions shall be provided.

301S.5 Construction

Typical materials used for specific applications are identified in Table 17. These are typical uses only and circumstances may require use of other material.

Table 17: Typical Material Use

Material Application	Typically Used Materials
Hot-Mixed, Hot-Laid Asphalt Mixtures	PG Binders, Modified PG Binders
Surface Treatment	AC-5, AC-10, AC-5 w/2% SBR, AC-10 w/2% SBR, AC-15P, AC-15-5TR, HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, Surface Treatment
(Cool Weather)	RS-1P, CRS-1P, RC-250, RC-800, RC-3000, MC-250, MC-800, MC-3000, MC-2400L
Precoating	AC-5, AC-10, PG 64-22, SS-1, SS-1H, CSS-1, CSS-1H
Tack Coat	RC-250, SS-1, SS-1H, CSS-1, CSS-1H, EAP&T
Fog Seal	SS-1, SS-1H, CSS-1, CSS-1H
Hot-Mixed, Cold-Laid Asphalt Mixtures	AC-0.6, AC-1.5, AC-3, AES-300, AES-300P, CMS-2, CMS-2S
Patching Mix	MC-800, SCM I, SCM II, AES-300S
Recycling	AC-3, AES-150P, AES-300P, Recycling Agent, Emulsified Recycling Agent
Crack Sealing	SS-1P, Polymer Mod AE Crack Sealant, Rubber Asphalt Crack Sealers (Class A, Class B)
Prime	MC-30, AE-P, EAP&T, PCE
Curing Membrane	SS-1, SS-1H, CSS-1, CSS-1H, PCE
Erosion Control	SS-1, SS-1H, CSS-1, CSS-1H, PCE

301S.6 Storage, Heating and Application Temperatures

Asphaltic materials should be applied at the temperature, which provides proper and uniform distribution. Within practical limits higher temperatures than necessary to produce the desired results shall be avoided. Satisfactory application usually should be obtained within the recommended ranges shown below.

No material shall be heated above the following maximum temperatures:

Table:18 Recommended Temperature Ranges

Type-Grade	Recommended Range; °F (°C)	Maximum Temperature; °F (°C) for	
	Application/Mixing	Allowable Application	Storage
AC-5, 10,20,30	275—350 (135—177)	375 (191)	400 (204)
AC-5 or AC-10 + 2% SBR	300—375 (142—191)	390* (199)	375 (191)
AC-10 + 3% SBR, AC-45P	300—350 (142—191)	350 (177)	360 (182)

RC-250	125—180 (52—82)	200 (93)	200 (93)
RC-800	170—230 (77—110)	260 (127)	260 (127)
RC-3000	215—275 (102—135)	285 (141)	285 (141)
MC-30, AEP	70—150 (21—66)	175 (79)	175 (79)
MC-70	125—175 (52—79)	200 (93)	200 (93)
MC-250	125—210 (52—99)	240 (116)	240 (116)
MC-800, SCM I, SCM II	175—260 (79—127)	275 (135)	275 (135)
MC-3000 & MC-2400 Latex	225—275 (107—135)	290 (143)	290 (143)
HFRS-2, MS-2, CRS-2, CRS-2H, HFRS-2P, CRS-2P, CMS-2, CMS-2S, AES-300, AES-300S, AES-150P, AES- 300P	120—160	180	180
SS-1, SS-1h, SS-1P, CSS-1, CSS-1h, PCE, EAP & T, SS- 1P, RS-1P, CRS-1P, CSS- 1P, recycling agent, emulsified recycling agent, polymer modified AE crack sealant.	50—130 (10—54)	140 (60)	140 (60)
RS-2, RS-2h, MS-2, CRS-2, CRS-2h, CRS-2p, CMS-2, CMS-2S, HFRS-2, HFRS- 2p, AES-300	110—160 (43—71)	170 (77)	170 (77)
Special Precoat Material	125—250 (52—121)	275 (135)	275 (135)
PG Binders, Modified PG Binders	275—350	350	350
Rubber Asphalt Crack Sealers (Class A, Class B)	350—375	400	-
Rubber-Asphalt Crack Sealer	350—375 (177—191)	400 (204)	-

* AC-5 + 2% SBR and AC-10 + 2% SBR, which is designated for surface treatment work, may be heated to a maximum temperature of 390°F (200°C) by the supplier loading through an in-line heater, or with the permission of the Engineer or designated representative, these materials may be heated to maximum of 390°F (200°C) by the Contractor just prior to application. When any of the SBR-modified asphalt cements are used in asphaltic concrete, the storage temperature at the mix plant should not exceed 350°F (177°C).

Attention is called to the fact that asphaltic materials (except emulsions) are very flammable and constitute fire hazards. Proper precautions should be used in all cases, especially with RC cutbacks.

Utmost care shall be taken to prevent open flames from coming in contact with the asphaltic material or the gases of it. The Contractor shall be responsible for any fires or accidents, which may result from heating the asphaltic materials.

301S.7 Measurement and Payment

All asphaltic materials included in this specification will not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used.

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Specification Item 301S "Asphalts, Oils and Emulsions"</u>	
<u>American Association of State Highway and Transportation Officials (AASHTO)</u>	
<u>Designation</u>	<u>Description</u>
AASHTO T-44	Solubility of Bituminous Materials in Organic Solvents
AASHTO T-48	Flash and Fire Points by Cleveland Open Cup
AASHTO T-49	Penetration of Bituminous Materials
AASHTO T-50	Float Test for Bituminous Materials
AASHTO T-51	Ductility of Bituminous Materials
AASHTO T-53	Distillation of Road Tar
AASHTO T-55	Water in Petroleum Products and Bituminous Materials by Distillation
AASHTO T-59	Testing Emulsified Asphalt
AASHTO T-72	Saybolt Viscosity
AASHTO T-78	Distillation of Cut-Back Asphaltic (Bituminous) Products
AASHTO T-79	Flash Point with Tag Open-Cup Apparatus
AASHTO T-201	Kinematic Viscosity of Asphalts
AASHTO T-202	Viscosity of Asphalts by Vacuum Capillary Viscometer
AASHTO TP-1	Creep Stiffness
AASHTO TP-3	Direct Tension
AASHTO TP-5	Dynamic Shear
AASHTO TP-48	Rotational Viscometry
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-238-F	Laser Diffraction Particle Size Distribution Analyzer
Tex-509-C	Spot Test of Asphaltic Materials
Tex-525-C	Tests for Asphalt and Concrete Joint Sealers
Tex-533-C	Determination of Polymer Additive Percentages in Polymer Modified Asphalt Cements
Tex-539-C	
Tex-540-C	
Tex-541-C	
Tex-542-C	
Tex-543-C	
Tex-544-C	
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
D 217	Test Methods for Cone Penetration of Lubricating Grease
D 297	Test Methods for Rubber Products-Chemical Analysis
D 2186 Method A	Test Methods for Deposit-Forming Impurities in Steam

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(Supp. No. 5-2021)

D 6084	Test Method for Elastic Recovery of Bituminous Materials by Ductilometer
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RELATED CROSS REFERENCE MATERIALS	
<u>Specification Item 301S "Asphalts, Oils and Emulsions"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 206S	Asphalt Stabilized Base
Item No. 210S	Flexible Base
Item No. 302S	Aggregates for Surface Treatments
Item No. 306S	Prime Coat
Item No. 307S	Tack Coat
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 312S	Seal Coat
Item No. 313S	Rubber Asphalt Joint and Crack Sealant
Item No. 315S	Milling Asphaltic Concrete Paving
Item No. 320S	Two Course Surface Treatment
Item No. 340S	Hot Mix Asphaltic Concrete Pavement
Item No. 341S	Paving Fabric
Item No. 350S	Heating, Scarifying and Repaving
Item No. 351S	Recycling Agent
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
1000S-10	Local Street Sections
1000S-11(1)	Residential and Neighborhood collector Street Sections
1000S-11(2)	Industrial and Collector Street Sections
1000S-12(1)	Primary Collector Street Sections
1000S-12(2)	Primary Arterial Street Sections
1000S-13(1)	Minor Arterial Street Sections (4 Lanes)
1000S-13(2)	Minor Arterial Street Sections (4 Lanes divided)
1000S-14	Major Arterial Street
<u>Texas Department of Transportation: Standard Specifications for Construction And Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 316	Surface Treatments
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 354	Planing and/or Texturing Pavement

Item 520	Weighing and Measuring Equipment
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-126-E	Molding, Testing and Evaluation of Bituminous Black Base Materials
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-211-F	Recovery of Asphalt from Bituminous Mixtures by Absorb
Tex-215-	Determination of Asphalt Content of Rock Asphalt Process by Hot Solvent Method
Tex-217-F	Determination of Deleterious Material and Decantation Test for Coarse Aggregates
Tex-224-F	Determination of Flakiness
Tex-400-A	Method of Sampling Stone, Gravel, Sand and Mineral Aggregates
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
Tex-438-A	Accelerated Polish Test for Aggregate
Tex-460-A	Determination of Crushed Face Particle
Tex-501-C	Test for Water in Petroleum Products and Other Bituminous Materials
Tex-502-C	Test for Penetration of Bituminous Material
Tex-503-C	Test for Ductility of Bituminous Materials
Tex-504-C	Test for Flash and Fire Points of Petroleum Materials by Cleveland Open Cup
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-505-C	Test for Softening Point of Bituminous Materials by Ring-and-Ball Method
Tex-506-C	Test for Loss on Heating of Oils and Asphaltic Compounds
Tex-507-C	Proportion of Bitumen Soluble in Trichloroethylene
Tex-510-C	Determining the Effect of Heat and Air on Asphaltic Materials when Exposed in Thin Films
Tex-512-C	Test for Flash Points of Volatile Flammable Materials by Tag Open-Cup Apparatus
Tex-513-C	Test for Saybolt Viscosity
Tex-515-C	Distillation of Cut-Back Asphalt Products
Tex-519-C	Float Test for Bituminous Materials
Tex-520-C	Test for Residue of Specified Penetration
Tex-521-C	Testing Emulsified Asphalts
Tex-528-C	Test for Absolute Viscosity of Asphalt Cements
Tex-529-C	Test for Kinematic Viscosity of Asphalts

ITEM NO. 302S AGGREGATES FOR SURFACE TREATMENTS 9-26-12

302S.1 Description

This item shall govern aggregate and precoated aggregate to be used in the construction of surface treatments.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

302S.2 Submittals

The submittal requirements of this specification item include:

- A. Aggregate types, gradations and physical characteristics (i.e. flakiness index, % wear, soundness, polish value, etc).
- B. Proposed proportioning of materials.
- C. Aggregate precoat and fluxing material.
- D. Type of mixing plant and associated equipage including chart indicating the calibration of each cold bin.
- E. Aggregate storage/stockpiling plans.

302S.3 Materials

A. Aggregates

Aggregates shall be composed of clean, tough and durable particles of gravel, crushed gravel, crushed stone, crushed slag or natural limestone rock asphalt. These materials shall not contain more than 2 percent by weight (mass) of soft particles and other deleterious materials as determined by TXDOT Test Method Tex-217-F, Part I. The natural limestone rock asphalt aggregate furnished shall have an average bitumen content from 4 to 7 percent by weight (mass) of naturally impregnated asphalt, as determined by TXDOT Test Method Tex-215-F and shall contain not more than 2 percent by weight (mass) of any one of or combination of iron pyrites or other objectionable matter, as determined by TXDOT Test Method Tex-217-F, Part I. No aggregate shall contain a total of more than 2 percent by weight (mass) of impurities or objectionable matter listed above.

The aggregate shall be either dark in color or be precoated. If not precoated, it shall be sufficiently washed as to produce a clean, dust free surface.

The aggregate shall not contain more than 1 percent loss from fine dust, clay-like particles and/or silt when tested in accordance with TXDOT Test Method Tex-217-F, Part II. The flakiness index for the aggregate, as determined by TXDOT Test Method Tex-224-F, shall not exceed 17 unless otherwise shown on the Drawings.

The percent of wear, as determined by TXDOT Test Method Tex-410-A (Los Angeles Abrasion Test), for each of the materials, except natural limestone rock asphalt (LRA), shall not exceed 35 percent. The percent of wear on natural limestone rock asphalt aggregate (LRA) shall not exceed 40 percent as determined by TXDOT Test Method Tex-410-A on that portion of the material retained on the No. 4 (4.75 mm) sieve, having a impregnated asphalt content of less than 1 percent.

Unless indicated otherwise on the drawings crushed gravel shall have a minimum of 85 percent of the particles retained on the No. 4 (4.75 mm) sieve with two or more mechanically induced crushed faces, as determined by TXDOT Test Method Tex-460-A, Part I.

The aggregate will be subjected to five (5) cycles of magnesium sulfate soundness testing in accordance with Test Method Tex-411-A. The loss shall not exceed 25 percent, unless indicated otherwise on the Drawings.

The polish value for the aggregate used in the surface or finish course shall be the value shown on the Drawings, when tested in accordance with TxDOT Test Method Tex-438-A. Unless otherwise shown on the Drawings, a minimum polish-value requirement of 30 will apply only to aggregate used in the travel lanes.

When aggregates requiring polish value are supplied from a source rated for a previous City of Austin roadway project or rated by TxDOT Materials and Tests Division, the Rated Source Polish Value (RSPV) for that source will be used to meet this requirement. When aggregates are supplied from a source that is not rated, the aggregate will be sampled and tested prior to use. The procedures will be in accordance with TxDOT Test Methods Tex-400-A and Tex-438-A, Part I. Blending of aggregates to achieve polish value will not be permitted, unless otherwise shown on the Drawings. If blending is allowed, TxDOT Test Method Tex-438-A, Part II, Method B will be used to determine the required blend percentages. However, a minimum of 50 percent by volume of non-polishing aggregate is required.

B. Precoat Material and Fluxing Material

1. The precoat material shall meet requirements for "Precoat Materials" as specified in Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions".
2. The fluxing material shall meet the requirements for "Fluxing Material " as specified in Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions".
3. Water in an amount not to exceed 3 percent by weight (mass) of the mixture may be used in preparing the mixture. The water shall be added as directed by the Engineer or designated representative during the mixing. In the event water is used in the mixing operation, adequate measuring devices shall be used and the water shall be administered to the mix through an approved spray bar. Potable water from City of Austin supplies is preferred, but the Contractor may submit test results of other water sources for approval by the Engineer or designated representative before use.

302S.4 Types of Aggregates

The various types of aggregates are identified as follows:

A. Uncoated Aggregate Types.

Type	Description
A	gravel, crushed slag, crushed stone or natural limestone rock asphalt (LRA)
B	crushed gravel, crushed slag, crushed stone or natural limestone rock asphalt (LRA)
C	gravel, crushed slag or crushed stone
D	crushed gravel, crushed slag or crushed stone
E	Aggregate as shown on drawings
F	Trap Rock

B. Precoated Aggregate.

Precoated aggregate shall be aggregate of the type and grade specified above, coated with 0.5 to 1.5 percent, by mass, of residual bitumen from a precoating material. When indicated on the drawings, specific aggregates may be prohibited from being precoated.

Where limestone rock asphalt (LRA) is used, it shall be fluxed with 0.5 to 1.5 percent by mass of fluxing material. Limestone rock asphalt (LRA) that contains visual surface moisture or excessive quantities of fines shall not be precoated.

The grade of aggregate specified shall meet all requirements of sections 302S.3 and 302S.4 prior to the application of the precoat or fluxing material.

The materials may be mixed on the job or at a central mixing plant and shipped ready for use. Mixes that do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by approved mechanical spreading devices will not be acceptable.

Materials that are not uniformly and/or properly coated, in the opinion of the Engineer or designated representative, will not be accepted for use.

The various types of precoated aggregates are identified as follows:

Precoated Aggregate Types

Type	Description
PA	gravel, crushed slag, crushed stone or natural limestone rock asphalt (LRA)
PB	crushed gravel, crushed slag, crushed stone or natural limestone rock asphalt (LRA)
PC	gravel, crushed slag or crushed stone
PD	crushed gravel, crushed slag or crushed stone
PE	Aggregate as shown on drawings

302S.5 Grades

When tested by TXDOT Test Method Tex-200-F, Part I, the gradation requirements for the several grades of aggregate shall be as follows:

Sieve Designation		Percent Retained By Weight (Mass) for				
US	SI	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
1 inch	25.0 mm	0				
7/8 inch	22.4 mm	0—2	0			
3/4 inch	19.0 mm	20—35	0—2	0		
5/8 inch	16.0 mm	85—100	20—40	0—2	0	
1/2 inch	12.5 mm		80—100	20—40	0—5	0
3/8 inch	9.5 mm	95—100	95—100	80—100	20—40	0—5
1/4 inch	6.25 mm			95—100		
No. 4	4.75 mm				95—100	50—80
No. 20	2.36 mm	99—100	99—100	99—100	98—100	98—100

302S.6 Equipment For Precoating Aggregate

Mixing plants that will not continually meet all the requirements of this specification shall be rejected.

Mixing plants may be either the weigh batching type, the continuous mixing type or the drum mix type. Each type of plant shall be equipped with satisfactory conveyors, power units, aggregate handling equipment, aggregate screens and bins and shall consist of the essential pieces of equipment listed below:

If the Engineer or designated representative approves the use of emulsion as a precoat material, the Engineer or designated representative may also waive the requirement for a dryer, as specified below, if it is demonstrated that a satisfactory coating can be obtained without drying or heating the aggregate.

When using a low grade fuel oil or waste oil, the plant shall meet the requirements of article 340.4.(2) of TxDOT Specification Item 340, "Hot Mix Asphaltic Concrete Pavement".

A. Weigh Batching Type

1. Cold Aggregate Bin and Proportioning Device

The cold aggregate bins or aggregate stockpiles shall be of sufficient number and size to supply the amount of aggregate required to keep the plant in continuous operation. The proportioning device shall be such as will provide a uniform and continuous flow of aggregate to the plant in the desired proportions.

2. Dryer

The dryer shall be of the type that continually agitates the aggregate during heating and in which the temperature can be so controlled that aggregate will not be damaged in the necessary drying and heating operations, which are required to obtain a mixture of the specified temperature.

3. Burner

The burner or combination of burners and type of fuel used shall be such that in the process of heating the aggregate to the desired or specified temperatures, no residue from the fuel shall adhere to the heated aggregate. A recording thermometer shall be provided which will record the temperature of the aggregate when it leaves the dryer. The dryer shall be of sufficient size to keep the plant in continuous operation. The dryer will not be required for precoating natural limestone rock asphalt.

4. Screening and Proportioning

The screening capacity and size of the bins shall be sufficient to screen and store the amount of aggregate required to properly operate the plant and keep the plant in continuous operation at full capacity. Proper provisions shall be made to enable inspection forces to have easy and safe access to the proper location on the mixing plant where accurate representative samples of aggregate may be taken from the bins for testing.

5. Weighing and Measuring Equipment

The weighing and measuring equipment shall be of sufficient capacity and of adequate design for proper batching. The following equipment, conforming to the requirements of the TxDOT Standard Specification, Item No. 520, "Weighing and Measuring Equipment", shall be furnished:

- (a) Aggregate weigh box and batching scales.
- (b) Bucket and scales for precoat material for flux oil.

A pressure type flow meter may be used to measure the precoat material or fluxing material for each batch.

If a pressure type flow meter is used to measure the asphaltic material, the requirements of TxDOT Specification Item 520, "Weighing and Measuring Equipment", shall apply.

Provisions of a permanent nature shall be made for checking the accuracy of the asphaltic material measuring device. The line to the measuring device shall be protected with a jacket of hot oil or other means approved by the Engineer to maintain the temperature of the line near the temperature specified for the precoating material.

6. Mixer

The mixer shall be of the pug mill type and shall have a capacity of not less than 3000 pounds (1350 kilograms) in a single batch. The number of blades and the position of same shall be such as to give a uniform and complete circulation of the batch in the mixer. The mixer shall be equipped with an approved spray bar that will distribute the precoat material or fluxing material quickly and uniformly throughout the mixer. Any mixer that has a tendency to segregate the mineral aggregate or fails to secure a thorough and uniform mixing with the precoat material or fluxing material shall not be used. All mixers shall be provided with an automatic time lock that will lock the discharge doors of the mixer for the required mixing period. The dump door or doors and the shaft seals of the mixer shall be tight enough to prevent the spilling of aggregate or mixture from the pug mill.

B. Continuous Mixing Type

1. Cold Aggregate Bin and Proportioning Device.

Same as for weigh batching type of plant.

2. Dryer.

Same as for weigh batching type of plant.

3. Screening and Proportioning.

Same as for weigh batching type of plant. These requirements shall also apply to materials that are stockpiled and that are proposed for direct use by a continuous mixing plant without the use of plant bins.

4. Aggregate Proportioning Device.

The aggregate proportioning device shall be so designed, that when properly operated, a uniform and continuous flow of aggregate into the mixer will be maintained.

5. Spray Bar for Precoat Material and Fluxing Material.

The spray bar for the precoat material or fluxing material shall be so designed that the material will spray uniformly and continuously into the mixer.

6. Meter for Precoat Material or Fluxing Material.

An accurate recording meter for precoat material or fluxing material shall be placed in the line leading to the spray bar so that the accumulative amount of precoat material or fluxing material being used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of the meter output.

7. Mixer

The mixer shall be of the pug mill continuous type and shall have a capacity of not less than 40 tons (36 megagrams) of mixture per hour. Any mixer that has a tendency to segregate the aggregate or fails to secure a thorough and uniform mixing of the aggregate with the precoat material or fluxing material shall not be used.

C. Drum Mix Plant

Unless otherwise indicated on the Drawings or if natural limestone rock asphalt is to be used, the Contractor may elect to use the drum-mixing process. The plant shall be adequately designed and constructed for the process of mixing aggregates and precoat material in the dryer-drum without preheating the aggregates. The plant shall be equipped with satisfactory conveyors, power units, aggregate-handling equipment and feed controls and shall consist of the following essential pieces of equipment.

1. Cold Aggregate Bin and Feed System

The number of compartments in the cold aggregate bin shall be equal to or greater than the number of stockpiles of individual materials to be used.

The bin shall be of sufficient size to store the amount of aggregate required to keep the plant in continuous operation and of proper design to prevent overflow of material from one compartment to another. There shall be vertical partitions meeting the requirements of article 340.4. (2) of TxDOT Specification Item 340, "Hot Mix Asphaltic Concrete Pavement". The feed system shall provide a uniform and continuous flow of aggregate in the desired proportion to the dryer. The Contractor shall furnish a chart indicating the calibration of each cold bin in accordance with the manufacturer's recommendations or in a method acceptable to the Engineer or designated representative.

The system shall provide positive weight (mass) measurement of the combined cold aggregate feed by use of belt scales or other approved devices. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device, as required by TxDOT Specification Item 520, "Weighing and Measuring Equipment". When a belt scale is used, mixture production shall be maintained so that the scale normally operates between 50 percent and 100 percent of its rated capacity. Belt scale operation below 50 percent of the rated capacity may be allowed by the Engineer or designated representative if accuracy checks show the scale to meet the requirements of TxDOT Specification Item 520, "Weighing and Measuring Equipment", at the selected rate and it can be satisfactorily demonstrated to the Engineer or designated representative that mixture uniformity and quality have not been adversely affected.

2. Scalping Screen

A scalping screen shall be required, unless otherwise indicated on the Drawings and shall be located ahead of the combined aggregate belt scale.

3. Precoat Material Measuring System

An asphaltic material measuring device meeting the requirements of the TXDOT Item No. 520, "Weighing and Measuring Equipment", shall be placed in the line leading to the drum mixer so that the accumulative amount of precoat material used can be accurately determined. Provisions of a permanent nature shall be made for checking the accuracy of the measuring device output. The measuring device and line to the measuring device shall be protected with a jacket of hot oil or other approved means to maintain the temperature of the line and measuring device near the temperature specified for the precoat material. The measuring system shall include an automatic temperature compensation device to maintain a constant percent by mass of precoating material in the mixture. Unless otherwise indicated, the temperature of the precoat material entering the measuring device shall be maintained at +100F (+60C) of the temperature at which the measuring set was calibrated and set.

4. Synchronization Equipment for Feed-Control Systems

The precoat material feed-control shall be coupled with the total aggregate weight (mass) measuring device in such a manner as to automatically vary the precoat material feed rate as required to maintain the required proportion.

5. Drum Mix System

The drum mix system shall be of the type that continually agitates the aggregate and precoat mixture during heating, and in which the temperature can be so controlled that aggregate and asphalt will not be damaged in the necessary drying and heating operations that are required to obtain a mixture at the specified temperature. A continuously-recording thermometer shall be provided which will indicate the temperature of the mixture as it leaves the drum mixer.

6. Surge-Storage System

A surge-storage system will be required. It shall be adequate to minimize the production interruptions during the normal day's operations and shall be constructed to minimize segregation. A device such as a gob hopper or other similar devices approved by the Engineer or designated representative to prevent segregation in the surge-storage bin will be required.

7. Heating Equipment for Precoat Material and Fluxing Material

Heating equipment for precoat material and fluxing material shall be adequate to heat the amount of material required to the desired temperature. The material may be heated by steam coils which shall be absolutely tight. Direct fire heating will be permitted, provided the heater used is manufactured by a reputable concern and there is positive circulation of the liquid throughout the heater. Agitation with steam or air will not be permitted. The heating apparatus shall be equipped with a recording thermometer with a 24-hour chart that will record the temperature of the precoat material or fluxing material where it is at the point of highest temperature.

302S.7 Storage, Proportioning and Mixing

A. Aggregate Storage

If the mineral aggregates are stored or stockpiled, they shall be handled in such a manner as to prevent segregation, mixing of the various materials or sizes and contamination with foreign materials. The grading of aggregates proposed for use and as supplied to the mixing plant shall be uniform. When directed by the Engineer or designated representative, aggregate materials shall not be added to stockpiles that have already been sampled for approval.

When asphalt cement is the precoating material, stockpile height shall be limited to approximately three (3) feet (one meter) immediately after production to limit the build up of heat. These stockpiles may be consolidated after cooling adequately, in the opinion of the Engineer or designated representative.

The use of limestone rock asphalt aggregate containing moisture in excess of the saturated surface-dry condition will not be permitted. Excess moisture will be evidenced by visual surface moisture on the aggregate or any unusual quantities of fines clinging to the aggregate.

B. Storage and Heating of Precoating Material or Fluxing Material

The precoating or fluxing material storage shall be ample to meet the requirements of the plant. The precoating materials shall not be heated in storage to a temperature in excess of 2500F (1200C) or the maximum temperature established in Standard Specification Item Number 301S, "Asphalts, Oils and Emulsions". All equipment used in the storage and handling of precoat material or fluxing material shall be kept in a clean condition at all times and shall be operated in such manner that there will be no contamination with foreign matter.

C. Feeding and Drying of Aggregate

The feeding of various sizes of aggregate, other than natural limestone rock asphalt, to the dryer shall be done through the cold aggregate bin and proportioning device in such a manner that a uniform and constant flow of material in the required proportions will be maintained. The aggregate shall be heated to the temperature necessary to produce a mixture meeting the requirements of Article 302S.A.3 and 302S.7.

D. Proportioning

The proportioning of the various materials entering into the mixture shall be as directed by the Engineer or designated representative and in accordance with these specifications. Aggregate shall be proportioned by weight (mass) using the weigh box and batching scales herein specified when the weigh-batch type of plant is used and by volume using the aggregate proportioning device when the continuous mixer type of plant is

used. The precoat material or fluxing material shall be proportioned by weight (mass) or by volume based on weight (mass) using the specified equipment.

E. Mixing

1. Batch Type Mixer

In the charging of the weigh box and the charging of the mixer from the weigh box, such methods or devices shall be used as are necessary to secure a uniform mixture. In introducing the batch into the mixer, the mineral aggregate shall be introduced first; shall be mixed thoroughly, as directed, to uniformly distribute the various sizes throughout the batch before the precoat material or fluxing material is added; the precoat material or fluxing material shall then be added and the mixing continued until such time that the aggregate is properly coated. This mixing period may be varied, if in the opinion of the Engineer or designated representative the mixture is not uniform.

2. Continuous Type Mixer and Drum Mixer

The amount of aggregate and precoat material or fluxing material entering the mixer and the rate of travel through the mixer shall be so coordinated that a uniform mixture of the specified grading and percent by weight (mass) of precoat material or fluxing material will be produced.

302S.8 Physical Properties of the Mixture

The materials shall be mixed at a central mixing plant and shipped ready for use. Mixes that do not remain workable over a sufficient period of time or do not maintain flow qualities such that the precoated aggregate may be satisfactorily spread by normal approved mechanical spreading devices will not be acceptable. Materials that are not uniformly and/or properly coated or fluxed, in the opinion of the Engineer or designated representative will not be accepted for use.

302S.9 Measurement and Payment

Aggregates and precoated aggregates provided in accordance with this specification will not be paid for directly but shall be included in the unit price bid for the item of construction in which this item is used.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 302S "Aggregates for Surface Treatments"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 340S	Hot Mix Asphaltic Concrete Pavement
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 520	Weighing and Measuring Equipment
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-215-F	Determination of Asphalt Content of Rock Asphalt By Hot Solvent Method

Tex-217-F	Determination of Deleterious Material and Decantation Test For Coarse Aggregates
Tex-224-F	Determination of Flakiness
Tex-400-A	Method of Sampling Stone, Gravel, Sand and Mineral Aggregates
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
Tex-438-A	Accelerated Polish Test for Aggregate
Tex-460-A	Determination of Crushed Face Particle

RELATED CROSS REFERENCE MATERIALS	
<u>Specification Item 302S "Aggregates for Surface Treatments"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 206S	Asphalt Stabilized Base
Item No. 210S	Flexible Base
Item No. 306S	Prime Coat
Item No. 307S	Tack Coat
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 320S	Two Course Surface Treatment
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
1000S-10	Local Street Sections
1000S-11 (1)	Residential and Neighborhood collector Street Sections
1000S-11 (2)	Industrial and Collector Street Sections
1000S-12 (1)	Primary Collector Street Sections
1000S-12 (2)	Primary Arterial Street Sections
1000S-13 (1)	Minor Arterial Street Sections (4 Lanes)
1000S-13 (2)	Minor Arterial Street Sections (4 Lanes divided)
1000S-14	Major Arterial Street
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-126-E	Molding, Testing and Evaluation of Bituminous Black Base Materials
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures

ITEM NO. 306S PRIME COAT 2-24-10

306S.1 Description

This item shall govern the application of asphaltic material on the completed base course and/or other approved areas in accordance with the Drawings, these specifications or as directed by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

306S.2 Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. prime material, dispersal agent, etc.).
- B. Temperature Viscosity data and proposed temperature of application.
- C. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed pressure distributor including calibration documentation.
- D. List of facilities and equipment proposed for temperature measurements.
- E. List of facilities and equipment proposed for storage and handling of asphaltic materials.

306S.3 Materials

A. Asphalt Materials

The asphalt material for Prime Coat shall meet the requirements of Cutback Asphalt, MC-30, Emulsion, SS-1, Emulsion CSS-1 or AE-P, Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions".

B. Water

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

C. Dispersal Agent

Agent shall be added to water and sprayed on surfaces to be primed in accordance with asphalt manufacturer's recommendations.

306S.3 Construction Methods

When, in the opinion of the Engineer or designated representative, the base course or other surface is satisfactory to receive the prime coat, the surface shall be prepared by sweeping or other approved methods as directed by the Engineer or designated representative. The surface shall be lightly sprinkled with water just prior to application of the asphaltic material unless this requirement is waived by the Engineer or designated representative. The Contractor shall submit a list of prime material(s) recommended for application on the work to the Engineer or designated representative for approval. When emulsions are approved, a dispersal agent shall be added to the water before sprinkling.

The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor operated so as to distribute the prime coat at a rate ranging from 0.1 to 0.3 gallons per square yard (0.45 to 1.36 liters per square meter) of surface area. The material shall be evenly and smoothly distributed under pressure sufficient to assure proper distribution. During the application of prime coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. The Contractor shall be responsible for cleaning all splattered areas.

Prime Coat may be applied when the temperature of the surface on which the prime coat is to be placed is 60°F (16°C) or above and the air temperature is above 50°F (10°C) and rising; the air temperature being taken in the shade and away from artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer or designated representative, are not suitable.

The Contractor shall provide all necessary facilities and equipment for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two (2) distributor loads.

The distributor shall have been calibrated within three (3) years from the date it is first used on this project. The Engineer or designated representative shall be furnished an accurate and satisfactory record of such calibration. After beginning the work, if the yield on the asphaltic material applied appears in error, the distributor shall be calibrated in a manner satisfactory to the Engineer or designated representative before proceeding with the work.

The Contractor shall be responsible for the maintenance of the surface until the work is accepted by the Engineer or designated representative. No traffic, hauling or placement of any subsequent courses shall be permitted over the freshly applied prime coat for a minimum of 48 hours or until the prime coat is accepted as dry and cured completely by the Engineer or designated representative.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and they shall be operated in such a manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

The Engineer or designated representative will approve the temperature of application based on the temperature-viscosity relationship that will permit application of the asphalt within the limits recommended in Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions". The Contractor shall apply the asphalt at a temperature within 150F (80C) of the temperature specified in Standard Specification Item No. 301S, "Asphalt, Oils and Emulsions".

306S.5 Measurement

The prime coat will be included in the unit price bid for Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement" unless included as a separate pay item in the contract. When included for payment, it shall be measured at point of delivery on the project in gallons (liters: 1 liter equals 0.264 gallons) at the applied temperature. The quantity to be paid for shall be the number of gallons used in the accepted prime coat.

306S.6 Payment

The work performed and materials furnished as prescribed by this item, when included as a contract pay item, will be paid for at the unit bid price per gallon for "Prime Coat". The price shall include full compensation for cleaning the base course or other surface, for furnishing, heating, hauling and distributing the prime coat specified; for all freight involved and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

Pay Item No. 306S:	Prime Coat	Per Gallon.
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End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 306S "Prime Coat"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 340S	Hot Mix Asphaltic Concrete Pavement

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 306S "Prime Coat"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 206S	Asphalt Stabilized Base
Item No. 210S	Flexible Base
Item No. 307S	Tack Coat
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 320S	Two Course Surface Treatment
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
1000S-10	Local Street Sections
1000S-11 (1)	Residential and Neighborhood collector Street Sections
1000S-11 (2)	Industrial and Collector Street Sections
1000S-12 (1)	Primary Collector Street Sections
1000S-12 (2)	Primary Arterial Street Sections
1000S-13 (1)	Minor Arterial Street Sections (4 Lanes)
1000S-13 (2)	Minor Arterial Street Sections- (4 Lanes divided)
1000S-14	Major Arterial Street
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 520	Weighing and Measuring Equipment

ITEM NO. 307S TACK COAT 2-24-10

307S.1 Description

This item shall govern the application of asphaltic material on completed base courses, existing pavement, bituminous surface, bridge deck, slab or prepared surface as indicated on the Drawings and as directed by the Engineer or designated representative. The application of asphaltic material on completed base courses shall only be applied after the prime coat has completely cured in accordance with Standard Specification Item No. 306S, "Prime Coat"

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

307S.2 Submittals

The submittal requirements of this specification item include:

- A. List of recommended materials (i.e. tack coat material, sand type, etc.).
- B. Temperature Viscosity data and proposed temperature of application.
- C. Characteristics (i.e. manufacturer, rate of application, speed, etc.) of the proposed pressure distributor including calibration documentation.
- D. List of facilities and equipment proposed for temperature measurements.
- E. List of facilities and equipment proposed for storage and handling of asphaltic materials.

307S.3 Materials

A. Asphalt Materials

The asphalt material for "Tack Coat" shall meet the requirements for Cutback Asphalt or Emulsified Asphalt, Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions" as listed below. Cutback asphalt shall be made by combining 50 to 70 percent by volume of the asphaltic material as specified for the type of paving mixture with 30 to 50 percent by volume of gasoline and/or kerosene. The type of material shall be selected from the following table:

Temperature of Surface, °F (°C)	40—70°F (5 to 21°C)	Over 70°F (Over 21°C)
	RS-2	SS-1
	RS-2H	
	RC-250	MC-70
	CRS-2	CSS-1
	CRS-2H	CSS-1h

B. Water

Water shall be furnished by the Contractor and shall be clean and free from industrial wastes and other objectionable matter.

C. Sand

Sand may be Grade 1 conforming to Standard Specification Item No. 403S, "Concrete Structures" or washed sand, largely siliceous, with the following gradation:

Sieve Designation	Percent Retained by Weight (Mass) Natural Sand	SI
US		
No. 8	2.36 mm	0
No. 16	1.18 mm	0—40
No. 30	600mm	25—65
No. 50	300mm	65—85
No. 100	150mm	85—98
No. 200	75mm	98—100

There shall not be more than 50 percent of the aggregate retained between any 2 sieves listed above and not more than 25 percent of the aggregate retained between the No. 50 (300 µm) and the No. 100 (150 µm) sieves.

307S.4 Construction Methods

Tack coat shall be applied when the surface on which the tack coat is to be placed is 600 F (160C) or above and the air temperature is above 500F (100C) and rising, where the air temperature is measured in the shade and away from any artificial heat. Asphaltic material shall not be placed when general weather conditions, in the opinion of the Engineer or designated representative, are not suitable.

Before the tack coat is applied, the surface shall be cleaned thoroughly to the satisfaction of the Engineer or designated representative. The asphaltic material shall be applied on the clean surface by an approved type of self-propelled pressure distributor, so operated as to distribute the tack coat at a rate not to exceed 0.10 gallon per square yard (0.45 liters per square meter) of surface, evenly and smoothly with sufficient pressure to provide proper distribution.

In those instances where the pavement mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated by the Engineer or designated representative. All contact surfaces of curbs and structures and all joints shall be cleaned thoroughly and painted with a thin uniform coat of the asphaltic material used for tack coat. The tack coat shall be rolled with a pneumatic tire roller to distribute the asphaltic material uniformly over the tacked area. During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutters or structures. The Contractor shall clean splattered areas.

The distributor shall have been calibrated within three (3) years from the date it is first used on this project. The Engineer or designated representative shall be furnished an accurate and satisfactory record of such calibration. After beginning of the work, if the yield on the asphaltic material applied appears in error, the distributor shall be calibrated in a manner satisfactory to the Engineer or designated representative before proceeding with the work.

The Contractor shall provide all necessary facilities and equipment for determining the temperature of the asphaltic material in all of the heating equipment and in the distributor, for determining the rate at which it is applied, and for securing uniformity at the junction of two (2) distributor loads.

The Contractor shall be responsible for the maintenance of the surface until the HMAC is placed over the tack coat or the work is accepted by the Engineer or designated representative. No traffic, hauling or placement of any subsequent courses shall be permitted over the freshly applied tack coat unless it is blotted by the application of sand as directed by the Engineer or designated representative.

All storage tanks, piping, retorts, booster tanks and distributors used in storing or handling asphaltic material shall be kept clean and in good operating condition at all times and they shall be operated in such a manner that there will be no contamination of the asphaltic material with foreign material. It shall be the responsibility of the Contractor to provide and maintain in good working order a recording thermometer at the storage heating unit at all times.

The Contractor shall apply the asphalt at a temperature that will permit application of the asphalt within the limits recommended in Standard Specification Item No 301S, "Asphalts, Oils and Emulsions". The application temperature shall be within 150 F (80C) of 1600 F (710C).

307S.5 Measurement

The asphaltic material for "Tack Coat" will be included in the unit price bid for Standard Specification Item 340S, "Hot Mix Asphaltic Concrete Pavement" unless included as a separate pay item in the contract. When included for payment, "Tack Coat" shall be measured at point of delivery on the project in gallons (liters: 1 liter equals 0.264 gallons) at the applied temperature. The quantity to be paid for shall be the number of gallons used.

307S.6 Payment

The work performed and materials furnished as prescribed by this item, when included as a contract pay item, will be paid for at the unit bid price per gallon for "Tack Coat". The price shall include full compensation for cleaning the area to receive the "Tack Coat"; for furnishing, heating, hauling and distributing the tack coat specified; for all freight involved and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

Pay Item No. 307S:	Tack Coat	Per Gallon.
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End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 307S "Tack Coat"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 340S	Hot Mix Asphaltic Concrete Pavement

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 307S "Tack Coat"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 206S	Asphalt Stabilized Base
Item No. 210S	Flexible Base
Item No. 306S	Prime Coat
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 320S	Two Course Surface Treatment
<u>City of Austin Standard Details</u>	

<u>Designation</u>	<u>Description</u>
1000S-10	Local Street Sections
1000S-11(1)	Residential and Neighborhood collector Street Sections
1000S-11(2)	Industrial and Collector Street Sections
1000S-12(1)	Primary Collector Street Sections
1000S-12(2)	Primary Arterial Street Sections
1000S-13(1)	Minor Arterial Street Sections (4 Lanes)
1000S-13(2)	Minor Arterial Street Sections- (4 Lanes divided)
1000S-14	Major Arterial Street
<u>Texas Department of Transportation: Standard Specifications for Construction And Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 300	Asphalts, Oils and Emulsions
Item 301	Asphalt Antistripping Agents
Item 310	Prime Coat (Cutback Asphaltic Materials)
Item 314	Emulsified Asphalt Treatment
Item 345	Asphalt Stabilized Base (Plant Mixed)
Item 520	Weighing and Measuring Equipment

ITEM NO. 313S CLEANING AND/OR SEALING JOINTS AND CRACKS (ASPHALTIC CONCRETE) 2-24-10

313S.1 Description

This item shall govern the cleaning and/or sealing of joints and cracks that are 1/16 inch (1.5 mm) or greater in asphaltic concrete pavement in conformity to the lines, grades and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

313S.2 Submittals

The submittal requirements of this specification item include:

- A. Sealant Type (Polymer Modified Emulsion, Rubber-Asphalt or Self-Leveling Low Silicone) and method of application (crack sealing, joint sealing, squeegee, etc),
- B. Manufacturer certification that the product to be supplied meets or exceeds the specification requirements,
- C. Manufacturer recommended procedures for preparation, dispensing, application, curing etc of the sealant, and
- D. Listing of the equipment proposed for the Work.

313S.3 Materials

Joints and/or cracks shall be sealed with the materials indicated on the Drawings. The materials shall meet the requirements shown below:

Material	Specification	Recommended Use
Polymer Modified Emulsion	301S;Subarticle 301S.3.I.1	Fine Cracks 1/16 to 1/8 in (1.5 to 3 mm)
Rubber-Asphalt Crack Sealing Compound	301S; Subarticle 301S.3.I.2	Cracks: ≥1/8 inches (≥ 3.2 mm)
Self-Leveling Low Modulus Silicon	Class 5, TxDot DMS-6310	Joints

Fine aggregate used to cover the crack-sealing compound shall meet with the approval of the Engineer or designated representative.

The sealing compound shall be delivered in the manufacturer's original sealed containers. Each container shall be legibly marked with the name of the manufacturer, the trade name of the sealer, the manufacturer's batch number or lot, the pouring temperature, and the safe heating temperature.

313S.4 Equipment

Equipment, tools and machinery necessary for proper prosecution of the Work shall be on the project and shall be approved by the Engineer or designated representative prior to the initiation of the joint and crack cleaning and sealing operations

313S.5 Heating and Application Equipment

A. Polymer Emulsified Emulsion

Polymer Emulsified Emulsion may be heated in a conventional asphalt distributor or in an asphalt heater equipped with an agitator to insure that the emulsified asphalt is circulated during the heating process and achieves a uniform temperature rise. Temperature gauges shall be provided at strategic locations to enable the operator to accurately control the temperature of the emulsion to avoid overheating the material. The unit shall be equipped with a gear-driven asphalt pump with adequate pressure to dispense the emulsion in joints and cracks.

B. Rubber-Asphalt Crack Sealing Compound

The sealant shall be heated in a double jacketed heater using a heat transfer oil so that no direct flame comes in contact with the shell of the vessel containing the sealing compound. The heater reservoir shall be equipped with an agitator to insure that the sealing compound is circulated during the heating process to achieve a uniform temperature rise and to maintain the desired temperature. Accurate temperature gauges and positive temperature controls shall be provided to monitor the temperature of the vessel contents and prevent overheating the material. The heater shall be equipped with a gear-driven asphalt pump with adequate pressure to dispense the rubber-asphalt crack sealing compound.

C. Self-Leveling Low Modulus Silicone

The sealant shall be prepared and dispensed using the manufacturer's recommended equipment.

313S.6 Joint and Crack Cleaning Equipment

All equipment used in cleaning joints and cracks shall be capable of delivering a sufficient volume of filtered air, free of oil, water or other contaminants, to insure the removal of all loose debris from the joints or cracks to be sealed.

When specified on the Drawings, joints shall be routed. The router shall be of sufficient size to rout the joints to the widths and depths shown on the Drawings.

313S.7 Construction Methods

The bonding surface of cracks and joints shall be cleaned of infiltrated material with compressed air or other methods approved by the Engineer or designated representative to a depth at least twice the joint or crack width. When routing of the joints is indicated on the Drawings, the joints shall be routed and blown clean with filtered compressed air. All material removed from joints and cracks shall be removed from the paved surface of the roadway.

No sealing of any joints or cracks shall be done when the joints or cracks are damp, unless drying of the joints and cracks with compressed air can be demonstrated and meets with the approval of the Engineer or designated representative.

The joint or crack sealing material shall be applied using a pressure nozzle. Polymer modified emulsion and rubber-asphalt crack sealing compound shall penetrate and completely fill each crack and/or joint. All cracks and/or joints filled with these materials shall be squeegeed. The amount of sealing compound used shall be limited so that after the squeegee has been applied, the finished band shall be no more than 1½ inches (38 mm) wide and shall not exceed a depth of ¼in. (3.2 mm) above the pavement surface.

Self-leveling low modulus silicone joint sealing compound shall be applied so that it penetrates the joint and fills so that the top of the sealant shall be ¼ to ⅜inch (6.4 to 9.5 mm) below the pavement surface.

When directed by the Engineer or designated representative, a light coating of fine aggregate shall be applied to the cracks and joints before opening to traffic to prevent tracking.

When the number of cracks is so great that crack sealing in the manner described previously is impractical, the area shall be squeegee sealed. Areas to be squeegee sealed shall be indicated on the Drawings or established by the Engineer or designated representative. When all cracks in the area have been cleaned, the crack sealing material shall be applied and the excess shall be squeegeed over the area between the cracks. All polymer modified emulsion or hot poured rubber squeegee sealed areas shall be covered immediately after application with a light coating of fine aggregate.

313S.8 Measurement

Accepted work performed under this item shall be included in the unit price bid for other pay items and will not be measured and paid for unless a separate pay item is provided in the contract documents.

If a pay item is included in the contract documents, acceptable work for "Polymer Modified Emulsion", "Rubber Asphalt Joint and Crack Sealer" or "Self-leveling Low Modulus Silicone" shall be measured by the linear foot (meter: 1 meter equals 3.281 feet) of cracks sealed.

If a pay item is included in the contract documents, acceptable work for "Polymer Modified Emulsion", "Rubber Asphalt Joint and Crack Sealer" or "Self-leveling Low Modulus Silicone" shall be measured by the pound (kilograms: 1 kilogram equals 2.205 pounds) of crack sealer used.

If a pay item is included in the contract documents, acceptable work for Squeegee seal with "Polymer Modified Emulsion" or "Rubber Asphalt Joint and Crack Sealer" shall be measured by the square yard (square meter: 1 square meter equals 1.196 square yards) of surface area sealed. The square yard (square meter) calculations will be based on neat dimensions of the sealed area

313S.9 Payment

When included as a pay item in the contract documents, the work performed and materials furnished as provided by this item and measured in accordance with Article 313S.8, "Measurement", will be paid for at the appropriate unit bid price bid. The unit bid prices shall include full compensation for cleaning and, if necessary, routing the crack/joint; furnishing, heating, hauling, and placing the crack sealer; all freight involved and all manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

Pay Item No. 313S-A:	Polymer Modified Emulsion Joint and Crack Sealer	Per Lineal Foot.
Pay Item No. 313S-B:	Rubber Asphalt Joint and Crack Sealer	Per Lineal Foot.
Pay Item No. 313S-C:	Self-leveling Low Modulus Silicone joint and Crack Sealer	Per Lineal Foot.
Pay Item No. 313S-D:	Polymer Modified Emulsion Joint and Crack Sealer	Per Pound of Sealer Used
Pay Item No. 313S-E:	Rubber Asphalt Joint and Crack Sealer	Per Pound of Sealer Used.
Pay Item No. 313S-F:	Self-leveling Low Modulus Silicone joint and Crack Sealer	Per Pound of Sealer Used.
Pay Item No. 313S-G:	Polymer Modified Emulsion Squeegee Sealing	Per square yard.
Pay Item No. 313S-H:	Rubber Asphalt Squeegee Sealing	Per square yard.

End

SPECIFIC CROSS REFERENCE MATERIALS

<u>Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
<u>Texas Department of Transportation: Departmental Materials Specifications</u>	
<u>Designation</u>	<u>Description</u>
DMS 6310	Joint Sealants and Seals

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 413S	Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 300	Asphalts, Oils and Emulsions
Item No. 352	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
Item No. 433	Joint Sealants and Fillers
Item No. 438	Cleaning and/or Sealing Joints and Cracks (Portland Cement Concrete)

ITEM NO. 340S HOT MIX ASPHALTIC CONCRETE PAVEMENT 9-26-12

340S.1 Description

This item shall govern base, level up, and pavement surface courses composed of a compacted mixture of aggregate and asphaltic cement mixed hot in a mixing plant. The hot mix asphaltic (HMA) concrete pavement shall be constructed on a previously completed and approved subgrade, subbase material, base material, concrete slab or existing pavement.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

340S.2 Submittals

The submittal requirements of this specification item may include:

- A. A mix design submittal including the plant corrected Job Mix Formula (JMF) for the hot mix asphaltic concrete.
- B. Certification that the aggregate materials meet appropriate quality requirements.
- C. Particle-size gradation and specific gravity tests on all aggregate materials.
- D. Certification that the asphalt cement for paving materials meet appropriate quality requirements.

340S.3 Materials

The Contractor shall furnish materials to meet the requirements specified herein and shall be solely responsible for the quality and consistency of the product delivered to the Project.

- A. Aggregate: The aggregate shall be composed of coarse aggregate, a fine aggregate and, if required or allowed, mineral filler and reclaimed asphalt pavement (RAP). RAP use will be allowed in all base course mixtures except as specifically excluded herein, in the Contract Documents or on the Drawings, provided no more than 20% RAP is used.

RAP use will not be permitted in pavement surface courses.

Aggregates shall meet the quality requirements of Table 1 and other requirements as specified herein. The aggregate contained in RAP will not be required to meet Table 1 requirements unless indicated otherwise on the Drawings.

1. Coarse Aggregate: Coarse aggregate is defined as that part of the aggregate retained on the No. 10 (2.00 mm) sieve and shall consist of clean, tough, durable fragments of crushed stone or crushed gravel of uniform quality throughout.

Gravel from each source shall be crushed to the extent that it has a minimum of 85% of the particles retained on the No. 4 (4.75 mm) sieve with two or more mechanically induced crushed faces as determined by TxDOT Test Method TEX-460-A (Part I). The material passing the No. 4 (4.75 mm) sieve and retained on the No. 10 (2.00 mm) sieve must be the produced from crushing aggregate that was originally retained on the No. 4 (4.75 mm) sieve.

2. Reclaimed Asphalt Pavement (RAP): RAP is defined as a salvaged, milled, pulverized, broken or crushed asphaltic pavement. The RAP to be used in the mix shall be crushed or broken to the extent that 100 percent will pass the 2-inch (50 mm) sieve.

The RAP shall be stockpiled in such a manner that assures that it will not become contaminated by dirt or other objectionable materials. Unless indicated otherwise on the Drawings, stockpiled, crushed RAP must not exhibit a decantation more than 5 percent or a plasticity index more than 8, when tested in accordance with TxDOT Test Method Tex-406-A, Part I, or Test Method Tex-106-E, respectively.

3. Fine Aggregate: Fine aggregate is defined as that part of the aggregate passing the No. 10 (2.00 mm) sieve and shall be of uniform quality throughout. A maximum of 15 percent of the total aggregate may be field sand or other uncrushed fine aggregate.

Screenings shall be supplied from sources whose coarse aggregate meets the abrasion and magnesium sulfate soundness loss requirements shown in Table 1.

- a. Unless indicated otherwise on the Drawings, stone screenings, which are the product of a rock crushing operation, are required and shall meet the following gradation requirements when tested in accordance with TxDOT Test Method Tex-200-F, Part I.

Material	Percent by Weight (Mass)
Passing ¾inch (9.50 mm) sieve	100
Passing No. 10 (2.00 mm) sieve	70—100
Passing No. 200 (75 µm) sieve	0—15

- b. Crushed gravel screenings may be used with, or in lieu of, stone screenings only when indicated on the Drawings. Crushed gravel screenings must be the product of crushing aggregate that was originally retained on the No. 4 (4.75 mm) sieve and must meet the gradation for stone screenings shown above.

4. Mineral Filler: Mineral filler shall consist of thoroughly dried stone dust, Portland cement, fly ash, lime or other mineral dust approved by the Engineer or designated representative. The mineral filler shall be free from foreign matter.

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Natural Resource Conservation Commission (TNRCC) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TNRCC and EPA authorizations to operate the facility.

Fly ash obtained from a source using a process fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Natural Resource Conservation Commission (TNRCC) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TNRCC and EPA authorizations to operate the facility.

The addition of baghouse fines or other collected fines will be permitted if the mixture quality is not adversely affected in the opinion of the Engineer or designated representative. In no case shall the amount of material passing the No. 200 (75 µm) sieve exceed the tolerances of the job-mix formula or the master gradation limits.

When tested by TEX-200-F (Part I or Part III, as applicable), the mineral filler shall meet the following gradation requirements. Baghouse fines are not required to meet the gradation requirements.

Material	Percent by Weight (mass)
Passing No. 30 (600 µm) Sieve	95—100
Passing No. 80 (187.5 µm) Sieve, not less than	75

Passing No. 200 (75 µm) Sieve, not less than	55
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TABLE 1: AGGREGATE QUALITY REQUIREMENTS *

Requirement	Test Method	Amount
COARSE AGGREGATE		
Deleterious Material, percent, maximum	Tex-217-F, I	1.5
Decantation, percent, maximum	Tex-217-F, II	1.5
Los Angeles Abrasion, percent, maximum	Tex-410-A	40
Magnesium Sulfate Soundness Loss 5 cycle, percent, maximum	Tex-410-A	30
FINE AGGREGATE		
Linear Shrinkage, maximum	Tex-107-E, II	3
COMBINED AGGREGATES		
Sand Equivalent Value, minimum	Tex-203-F	45

* - Aggregates, without added mineral filler or additives, combined as used in the job-mix formula (Plant Corrected).

B. Asphaltic Material:

1. Paving Mixture: Asphalt cement for the paving mixture shall conform to the requirements of Standard Specification Item No. 301S, "Asphalts, Oils and Emulsions", for AC-20 or PG64-22, Styrene (SBS) Modified Asphalt Cement, AC-SBS Blend AC-45P or PG76-22S, unless otherwise indicated in the Project Documents.
2. Tack Coat: Tack Coat shall conform to Standard Specification Item No. 307S, "Tack Coat".

C. Additives: Additives to facilitate mixing and/or improve the quality of the asphaltic mixture or tack coat may be used with the authorization of the Engineer or designated representative. The Contractor may choose to use either lime or a liquid anti-stripping agent to reduce moisture susceptibility of the aggregate.

340S.4 Paving Mixtures

An asphalt mixture design is developed by a laboratory process, which includes the determination of the quality and quantity of the asphalt cement and the individual aggregates, and the testing of the combined mixture (Laboratory Design). The Laboratory Design is subsequently revised to produce an appropriate job mix formula.

The job mix formula (JMF) lists the quantity of each component to be used in the mix after the laboratory design has been adjusted by running it through a particular plant (i.e. the mix design is Plant Corrected). The JMF will be the standard to which the Acceptance Plan will be applied. The JMF of one drum or batching unit shall not be used for another unit.

The Contractor shall submit to the Engineer on forms provided by the Engineer or designated representative, an asphalt mixture design reviewed, signed and sealed by a Registered Professional Engineer licensed in the State of Texas or certified by a TxDOT Level II Certified Asphalt Technician. An asphalt mixture design shall be submitted for a comprehensive review every two (2) years. Mix designs older than one year will not be accepted without a review of current test data of the proposed materials and current mix design to ensure that the materials meet specification requirements.

The JMF (Plant Corrected) shall be submitted to the Engineer or designated representative on a form provided by the Engineer through the Construction Inspector or Project Manager of the Project for review, for each individual

Project, a minimum of three (3) working days before the mixture is to be placed. Under no circumstances will a mixture be placed before its use is reviewed and approved by the Engineer or designated representative.

Performance of the mix design shall remain the responsibility of the Contractor.

- A. Mixture Design: The mix shall be designed in accordance with TxDOT Construction Bulletin C-14 and Test Method Tex-204-F to conform with the requirements herein. The master grading limits of the appropriate type and the JMF will be plotted on a graduated chart with sieve sizes raised to the 0.45 power and will be submitted to the Engineer or designated representative with the asphalt mixture design.

The Bulk Specific Gravity of aggregates in RAP will be determined on extracted aggregates.

- B. Types: The blend of coarse aggregate, fine aggregate, and mineral filler, if allowed, that is established by TxDOT Test Method Tex-200-F, Dry Sieve Analysis, shall conform to the master gradation shown in Table 2 for the type of specified mixture. The voids in the mineral aggregate (VMA) will be determined as a mixture design requirement only, in accordance with TxDOT Test Method Tex-207-F, and shall not be less than the value indicated in Table 2.

TABLE 2: Master Grading - Percent Passing by Weight (Mass) or Volume

Sieve Size US (SI)	Type A Coarse Base	Type B Fine Base	Type C Coarse Surface	Type D Fine Surface	Type F Fine Mixture
1½" (37.5 mm)	100				
1¼" (31 mm)	95—100				
1" (25 mm)		100			
¾" (22 mm)	70—90	95—100	100		
⅝" (15.5 mm)		75—95	95—100		
½" (12.5 mm)	50—70			100	
⅜" (9.5 mm)		60—80	70—85	85—100	100
¼" (6.25 mm)					95—100
No. 4 (4.75 mm)	30—50	40—60	43—63	50—70	
No. 10 (2.00 mm)	20—34	27—40	30—40	32—42	32—42
No. 40 (425 µm)	5—20	10—25	10—25	11—26	9—24
No. 80 (187.5 µm)	2—12	3—13	3—13	4—14	3—13
No. 200 (75 µm)	1—6*	1—6*	1—6*	1—6*	1—6*
VMA % minimum	11	12	13	14	15
Rec. Min. Lift	3" (75 mm)	2" (50 mm)	1¾" (70 mm)	1" (50 mm)	¾" (20 mm)

- C. Tolerances: Fluctuations in the aggregate gradation and asphalt content of the Job Mix Formula (JMF) shall not vary by more than the following criteria but the aggregate gradation shall be limited to the range of the master gradation as established by TEX-210-F.

SIEVES	Percent By Weight (Mass)
2" (50 mm) Sieve through No. 10" (2.00 mm) Sieve	±5.0
No. 40 (425 µm) through No. 200 (75 µm) Sieve	±3.0
Asphalt Content	±0.5

- D. Stability and Density: The mixture shall be designed at or near optimum density, as indicated on the Drawings, to conform to the following percent of Maximum Theoretical Density as measured by TxDOT Test Method TEX-227-F and Stability conforming to TxDOT Test Method TEX-208-F. The laboratory mixture shall

be molded in accordance with TxDOT Test Method TEX-206-F and the Bulk Specific Gravity determined in accordance with TxDOT Test Method TEX-207-F.

	Optimum Laboratory Density (%)		Laboratory Density (%)	
			Min.	Max.
Local Streets Surface Courses	96	94.5	97.5	35 Min.
Collectors & Arterials Surface Courses	96	94.5	97.5	40—60
All Base Courses	96	94.5	97.5	35 Min.

- E. Job Mix Formula Field Adjustments: The Contractor shall produce a mixture of uniform composition closely conforming to the reviewed JMF, that falls within the limits of the tolerances given above and the Acceptance Plan.

If it is determined by the City of Austin that adjustments to the JMF are necessary to achieve the specified requirements, the Engineer or designated representative may allow adjustments of the JMF within the following limits without a laboratory redesign of the mixture. The adjusted JMF shall not exceed the master grading criteria for the type of mixture specified. The proposed JMF adjustments shall not exceed 5 percent on any one sieve, ½-inch (12.5 mm) size and larger, or 3 percent on the sieve size below the ½-inch (12.5 mm) sieve of the JMF (Plant Corrected) reviewed for the Project.

When the proposed adjustments exceed either the 5 or 3 percent limits, and the Engineer or designated representative determines that the impact of these changes may adversely affect pavement performance, a new laboratory mixture design will be required.

The asphalt content may be adjusted with the concurrence of the Engineer or designated representative to maintain desirable laboratory density near the optimum value while achieving other mix requirements. However, increasing the asphalt content of the mixture in order to reduce pavement air voids will not be allowed. Also, if the percent air voids is determined to be less than 4 percent, adjustments shall be made to the plant production by the Contractor, within the tolerances as outlined above, so that an adequate air void level is attained.

340S.5 Equipment

The trucks that deliver the hot mix asphalt concrete material to the project shall be of sufficient number to insure a continuous paving operation. All equipment used for the production, placement and compaction of the mixture shall be maintained in good repair and operating conditions to the satisfaction of the Engineer or designated representative. All equipment shall be made available for inspection. If the Engineer or designated representative expresses concern about the condition of any equipment, it shall not be used until it is repaired to the satisfaction of the Engineer or designated representative.

- A. Mixing Plants: Plants may be of the weigh-batch type, the modified weigh-batch type or drum-mix type equipped with suitable material conveyers, power units, mixing equipment, aggregate proportioning devices, dryers, bins, dust collectors and sensing and recording devices as appropriate for the mixing plant type. The mixing plants shall meet the requirements specified in Section 340.4, 'Equipment' of TxDOT Specification Item No. 340, "Hot Mix Asphaltic Concrete Pavement".
- B. Spreading and Finishing Paving Machine: The paving machine shall be self-propelled and equipped with a heated compacting screed capable of producing a finish surface meeting the requirements of the street cross-section indicated on the Drawings and all surface criteria. Extensions to the screed shall have the same heating and compacting capabilities as the primary unit, except for use on variable depth tapered areas and/or as approved by the Engineer or designated representative.

The paving machine shall be equipped with an approved automatic dual longitudinal screed control system and an automatic transverse screed control system. The longitudinal controls shall be capable of operating from any longitudinal grade reference including a string line, ski, mobile string line or matching shoe. Unless indicated otherwise on the Drawings, the Contractor may use any one of these grade references. The selected grade reference equipment shall be maintained in good operating condition by personnel trained in the use of the specific type of equipment.

The Contractor shall furnish all labor and equipment required for establishing and maintaining appropriate grade reference.

- C. Rollers: The Contractor shall select rollers conforming to Item 230S, "Rolling (Flat Wheel)" and Item 232S, "Rolling (Pneumatic Tire)". Rollers that do not conform to these requirements shall be immediately removed from the Project.
- D. Motor Grader: A self-propelled power motor grader may only be used when its use is approved by the Engineer or designated representative. It shall have a blade of not less than 12 feet (3.66 meters) and a wheelbase of not less than 16 feet (4.88 meters). Smaller graders may be used for small irregular areas when approved by the Engineer or designated representative.
- E. Material Transfer Equipment: Equipment for transferring the HMA mixture from the hauling units or the roadbed to the spreading and finishing machine will be allowed unless indicated otherwise on the Drawings. Windrow pick-up equipment, if permitted by the Engineer or designated representative, shall be constructed in such a manner that substantially all of the HMA mixture deposited on the roadbed is picked up and loaded into the spreading and finishing machine. The HMA mixture shall not be contaminated with foreign material. The loading equipment shall be designed so that it does not interfere with the spreading and finishing machine in obtaining the required line, grade and surface without resorting to hand finishing.
- F. Straightedges and Templates: The Contractor shall provide a ten-foot (3.05 meter) straightedge acceptable to the Engineer or designated representative for surface testing. Satisfactory templates shall be provided as required by the Engineer or designated representative.

340S.6 Stockpiling Aggregates

Aggregates shall be stockpiled to facilitate blending. When the aggregate is not stockpiled on a hard, non-contaminant base, the bottom six-inch (150 mm) depth of the stockpiles shall not be used in asphaltic mixtures. Where space is limited at the plant site, the aggregate stockpiles shall be separated by walls or other appropriate barriers.

Aggregates shall be stockpiled and handled in a manner that will insure minimization of segregation and contamination. Aggregate and RAP stockpiles shall only contain material from a single source.

340S.7 Mixture Temperature

The Contractor shall select a target temperature for discharge of the HMA mixture from the mixer between 250°F (120°C) and 350°F (176°C) that is suitable to weather and Project conditions. The target temperature shall be reported to the Engineer or designated representative daily and recorded in the Daily Progress Report. The HMA mixture temperature shall not vary by more than 25°F (14°C) from the target temperature for discharge from the mixer. HMA mixtures that are discharged from the mixer at a temperature exceeding 360°F (182°C) or a temperature more than 50°F (28°C) below the target temperature shall not be accepted and shall not be placed on the Project.

340S.8 Mixture Storage

A surge-storage system may be used to minimize production interruptions during a normal day of operation. When approved by the Engineer or designated representative, overnight storage of HMA mixture in insulated storage bins may be used provided that material temperature and physical properties of the HMA mixture are not adversely affected. HMA mixtures that include hardened lumps shall not be used. Stored HMA mixtures shall not be exempt from any requirements provided in this specification.

When a surge-storage system is used, it shall be equipped with a device such as a gob hopper or other device approved by the Engineer or designated representative to prevent segregation in the surge-storage bin.

340S.9 Mixture Moisture Content

Hot mix asphalt (HMA) mixtures produced from any plant shall not have a moisture content in excess of 1 percent by weight (mass) when discharged from the mixer. The moisture content shall be determined in accordance with TxDOT Test Method Tex-212-F, Part II, except that the sample shall be left in the oven a total of not less than four (4) hours.

340S.10 Construction Methods

- A. General: The Contractor shall be responsible for the production, transportation, placement and compaction of the specified HMA paving mixture to the requirements of this specification. The Contractor shall also be responsible for providing a safe environment for inspection personnel to inspect the equipment and to acquire samples.

All hot mix asphalt concrete pavement surface courses shall be placed with a spreading and finishing (lay-down) machine only. All hot mix asphalt concrete pavement base layers with the possible exception of the first lift of the base layer shall also be placed with a spreading and finishing (lay-down) machine. Longitudinal pavement joints shall be located under the proposed lane lines. Density tests shall be taken prior to opening to traffic.

The first lift of a base layer may be placed with a motor grader if approved in advance by the Engineer or designated representative. The loose measure thickness of this first lift shall not exceed 6 inches (150 mm). If placed with a motor grader, the first lift shall achieve a minimum in-place relative density of 89% as determined by TxDOT test procedures TEX-207-F and TEX-227-F. All subsequent lifts should be placed with a spreading and finishing (lay-down) machine and shall be subject to the requirements of Section 340S.12, "Acceptance Plan". Density tests will be taken randomly to confirm compliance with the specification requirements.

For hot mix asphalt overlays, an automatic screed shall be used with outriggers.

Any material delivered to the Project that by visual inspection can reasonably be expected not to meet specification requirements (i.e. segregated or burned material, deficient or excess asphalt, low mixing temperature, visible contaminants, etc.), as determined by the Engineer or designated representative, shall not be used or left in place.

Equipment shall be inspected prior to use and, if found to be defective or in an operating condition that could potentially affect the quality of the finished pavement, as determined by the Engineer or designated representative, its use shall not be allowed. Leakage of fuels, oils, grease, hydraulic or brake fluids or other contaminants onto the prepared surface or newly-laid HMA layer will not be allowed and may require replacement of the affected pavement area.

The HMA paving mixture, when placed with a spreading and finishing machine, shall not be placed when the air temperature is below 50°F (10°C) and is falling, but it may be placed when the air temperature is above 40°F (4°C) and is rising.

The paving mixture, when used as a level-up course or when spread with a motor grader, shall not be placed when the air temperature is below 60°F (15°C) and is falling, but it may be placed when the air temperature is 50°F (10°C) and is rising. An HMA layer with a thickness of 1½ inches (37.5 mm) and less shall not be placed when the temperature of the surface on which the layer is to be placed is below 50°F (10°C). The temperature shall be taken in a shaded area away from artificial heat.

Additional surface temperature requirements may be included in the Contract Documents or indicated on the Drawings.

Surfaces to be paved shall be finished, primed, cured, broomed and tacked, as appropriate, to the satisfaction of the Engineer or designated representative. If the surface on which the first course of the paving mixture is to be placed is a flexible base course, and a cut-back asphalt is to be used as a prime coat, the flexible base shall have been primed and cured a minimum of 24 hours before the paving mixture may be placed. The 24-hour restriction will not apply to a flexible base that has been primed with material other than a cutback. However, the surface on which the tack coat and/or paving mixture are to be placed shall be in a dry condition.

Pavement shall be opened to traffic as soon as possible after temporary pavement markings or permanent markings are in place as indicated on the Drawings) or as directed by the Engineer or designated representative. Construction traffic allowed on pavements open to the public will be subject to all laws governing traffic on streets and highways.

- B. Tack Coat: The surface upon which the tack is to be placed shall be cleaned thoroughly to the satisfaction of the Engineer or designated representative. The surface shall be given a uniform application of tack coat as governed by Standard Specification Item No. 307S, "Tack Coat". The tack coat shall be applied, as directed by the Engineer or designated representative, with an approved sprayer at a rate not to exceed 0.05 gallons per square yard. (0.225 liters per square meter) of surface area. Where the paving mixture will adhere to the surface on which it is to be placed without the use of a tack coat, the tack coat may be eliminated when approved by the Engineer or designated representative. All contact surfaces of curbs, castings and all structures and all joints shall be painted with a thin uniform application of tack coat.

During the application of tack coat, care shall be taken to prevent splattering of adjacent pavement, curb and gutter and structures. Before the Work can be accepted, all splatter shall be removed by the Contractor at the Contractor's expense.

- C. Transporting Hot Mix Asphaltic (HMA) Concrete: The HMA mixture shall be hauled to the Work site in tight vehicles that were previously cleaned of all foreign material. Dispatching of the vehicles shall normally be arranged so that all material delivered is placed and all rolling completed during daylight hours. Nighttime paving may be allowed, when approved in advance by the Engineer or designated representative.

In cool weather or for long hauls, truck bodies containing the HMA mixture shall be covered.

If necessary, to prevent the HMA mixture from adhering to the truck body, the inside of the truck may be given a light coating of a release agent satisfactory to the Engineer or designated representative.

- D. HMA Placement: The HMA mixture shall be dumped and spread on the approved prepared surface with the spreading and finishing machine. When properly compacted, the finished pavement shall be smooth, of uniform texture and density and shall meet the requirements of the typical cross sections and the surface tests. In addition the placement of the HMA mixture shall be done without tearing, shoving, gouging or segregating the mixture and without producing streaks in the HMA layer.

Discharge of the HMA mixture into the finishing machine shall be controlled so that the spreading and finishing machine is not bounced or jarred and the required lines and grades shall be obtained without resorting to hand finishing except as permitted below in this Section.

Unless indicated otherwise on the Drawings, dumping of the HMA material in a windrow and then placing the HMA mixture in the finishing machine with windrow pick-up equipment will be permitted provided the temperature of the HMA mixture does not drop more than 50°F (28°C) below the target temperature before being placed by the finishing machine.

Under no circumstances will the HMA material be permitted to be dumped on or near the job site and then reloaded for hauling to the site of placement. Exceptions may be allowed if approved by the Engineer or designated representative.

The windrow pick-up equipment shall be operated in such a manner that substantially all the mixture deposited on the roadbed or prepared surface is picked up and loaded into the finishing machine without contamination by foreign material. The windrow pick-up equipment will also be so operated that the finishing machine will obtain the required line, grade and surface without resorting to hand finishing. Any operation of the windrow pick-up equipment resulting in accumulation and subsequent shedding of accumulated material into the HMA mixture will not be permitted.

When approved by the Engineer or designated representative, level-up courses may be spread with a motor grader that meets the requirements of this specification item.

The spreading and finishing machine shall be operated at a uniform forward speed consistent with the plant production rate, hauling capability and roller train capacity to result in a continuous operation. Stopping of the spreading and finishing machine between trucks is to be held to a minimum. If, in the opinion of the Engineer or designated representative, delivery of material is adversely affecting the condition of the HMA layer (excessive stopping of the spreading and finishing machine, loss of mixture temperature, etc.), the Engineer or designated representative may require paving operations to cease until acceptable methods are provided to minimize starting and stopping of the spreading and finishing machine.

The hopper gates of the spreading and finishing machine shall be adjusted to provide an adequate and consistent flow of material. This shall result in enough material being delivered to the augers so that they are operating approximately 85 percent of the time or more. The augers shall provide means to supply adequate flow of material to the center of the paver. Augers shall supply an adequate flow of material for the full width of the mat being placed, as approved by the Engineer or designated representative. Augers should be kept approximately one-half to three-quarters full of HMA mixture at all times during the paving operation.

When the HMA mixture is placed in a narrow strip along the edge of an existing pavement, or is used to level up small areas of an existing pavement or is placed in small irregular areas where the use of a finishing machine is not practical, the finishing machine may be eliminated when permitted by the Engineer or designated representative.

The paving material adjacent to castings and flush curb and gutter and structures shall be finished uniformly high so that when compacted, it will be slightly above but not more than 1/8 inch (3 mm) above the edge of the casting or gutter lip.

Construction joints of successive courses of HMA material shall be offset at least 6 inches (150 mm). Longitudinal joints in the layer shall be placed to coincide with lane lines as directed the Engineer or designated representative. Transverse joints shall be offset a minimum of 5 feet (1.5 meters).

- E. Compaction: The pavement layers/lifts shall be compacted thoroughly and uniformly to obtain the compaction and cross section meeting the requirements indicated on the Drawings and this specification item.

Regardless of the method used for compaction, all rolling to achieve specified density shall cease before the temperature of the HMA mixture drops below 175°F (80°C).

Rolling with a pneumatic tire roller shall be used to seal the surface. Rolling with a tandem or other steel-wheel roller shall be provided if required to iron out any roller marks. Surface sealing and removal of roller marks may be accomplished at HMA temperatures below 175°F (80°C).

Vibratory rollers shall not be allowed in the vibrating mode on layers with a plan thickness less than 1½ inches (37.5 mm).

The motion of the rollers shall be slow enough to avoid other than usual initial displacement. If any displacement occurs, it shall be corrected to the satisfaction of the Engineer or designated representative.

The roller shall not be allowed to stand on pavement, which has not been compacted to minimum density requirements. In order to prevent adhesion of the surface mixture to the steel-wheel rollers, the wheels shall be thoroughly moistened with water; however an excess of water will not be allowed. Necessary precautions shall be taken to prevent the dropping of diesel, gasoline, oil, grease or other foreign matter on the pavement, either when the rollers are in operation or when standing.

The edges of the pavement along curbs, headers and similar structures, and all places not accessible to the roller, or in such positions as will not allow thorough compaction with the rollers, shall be thoroughly compacted with lightly oiled tamps.

Rolling with a trench roller will be required on widened areas, in trenches and other limited areas where satisfactory density cannot be obtained with the approved rollers.

340S.11 Sampling and Testing

The HMA mixture shall be tested daily at the Project site for conformance to specification requirements. The Engineer or designated representative shall utilize a random selection method to determine sample locations based on the Contractor's anticipated production. Each day's anticipated production shall be divided into three (3) essentially equal single-pass, sub-area lots. Each day's sample locations shall be equally distributed over the three (3) sub-areas. If, due to the weather or plant malfunctions, the Contractor's daily-anticipated production is not attained, the random locations will not be recalculated. Also, no more than one location of the three (3) sub-areas shall be located in an irregular shaped area such as a cul-de-sac.

Unless directed otherwise by the Engineer or designated representative, a minimum of three bag samples and three correlating 6-inch (150-mm) cores will be obtained from each day's production.

Bag samples shall be taken during lay-down operations. The primary sampling point for the bag samples shall be from the windrow if a windrow elevator is used. If a windrow elevator is not used, the sample shall be taken from the middle of the paving machine hopper. This sampling location will require a stoppage in the paving operation in order for the Inspector to safely secure a sample from the hopper. One core shall be taken for every 2,000 single-pass square yards (1,675 single-pass square meters) with a minimum of three (3) cores for all projects. One core shall be taken at the same station and pass sampled for each of the bag samples. Cores shall be taken by the City's laboratory within 48 hours of pavement laydown unless otherwise directed by the Engineer or designated representative.

For total areas of less than 500 square yards (420 square meters), a total of only two bag samples and two correlating cores will be obtained. If the Contractor desires additional testing, it shall be at its own entire expense.

The Engineer or designated representative may alter, increase or waive the testing schedule to ensure that the Work performed and the material used meet specification requirements. Acceptability of the completed pavement shall be based on the average of test results for the Project as defined in Section 340S.12, "Acceptance Plan" of this item.

Gradation, asphalt content and stability value of the HMA mixture shall be reported for each of the bag samples. The stability value reported for each of the bag samples shall be the average of three (3) tests per bag.

Pavement thickness and density shall be determined from 6-inch (150 mm) field cores. For each day's placement, density of cores for which no corresponding bag samples were taken shall be determined by using the average Maximum Theoretical Density of the day's three (3) bag samples or as may otherwise be determined by the Engineer or designated representative.

When, in the opinion of the Engineer or designated representative, test results appear unrepresentative, additional testing may be authorized. The retesting will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original test results were erroneous, the original test results will be discarded. In the instance of erroneous original test results the subsequent first set of retests will be at the expense of the City of Austin.

Pavements with low-density results may be recored; but the pavement shall not receive any additional compactive effort.

Pavements that will not or cannot be cored within 48 hours shall be closed to both public and construction traffic.

340S.12 Acceptance Plan

For the purpose of the Acceptance Plan only, the "Paving Project" of each of the specified mixture types shall be defined by the Engineer or designated representative before the paving operation begins

Considerations for defining the Paving Project shall include paving operations staged due to traffic considerations, pavement structural section (i.e. with varying layer thicknesses), time required for paving, changes to the Job Mix Formula, phasing of large projects, or other factors affecting the consistency in the production, lay-down/compaction, use of completed portions, and/or aging of in-place material.

Acceptability of the completed pavement structure for a Paving Project shall be based on all daily averages of three test results and when approved by the Engineer or designated representative the overall average of all test results for each of the mixture/layer types specified on the Drawings.

Pay adjustments for two or more acceptance factors shall be accumulative. Pay adjustments of 100% unit price reduction shall require removal and replacement of the Work. Replacement materials shall be subject to all requirements of this specification. Alternatively, the Engineer or designated representative may allow the Work to remain in place without payment provided that the Work is warranted for an extended period under conditions as determined by the Engineer or designated representative. The decision of the Engineer or designated representative related to the removal and replacement of the Work shall be the final authority.

A. Non-Pay-Adjustment Acceptance Factors:

1. **Surface Characteristics:** Unless otherwise directed by the Engineer or designated representative, all pavements shall be tested for smoothness. Surfaces shall be tested with a 10-foot (3.05 meter) straightedge parallel to the roadway centerline and perpendicular to the centerline on flat, cross-slope sections. Maximum allowable deviation in 10 feet shall be 1/8 inch (1-mm per meter) parallel to the centerline and 1/4 inch (2-mm per meter) perpendicular to the centerline. Sections exceeding these maximums shall be corrected to the satisfaction of the Engineer or designated representative. The completed surface must meet the approval of the Engineer or designated representative for surface smoothness, finish and appearance.

If the surface ravel, ruts or deteriorates in any manner prior to the end of the warranty period, it will be the Contractor's responsibility to correct this condition at its own entire expense to the satisfaction of the Engineer or designated representative in conformance with the requirements of this specification.

For HMAC rehabilitation and overlay projects, if cracks develop in the pavement surface within the one-year warranty period, the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

For new HMAC roadways constructed in accordance with the Drawings and specifications, if cracks less than 1/4 inch (6 mm) in width develop in the pavement surface within the one year warranty period the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

If cracks equal to or greater than 1/4 inch (6 mm) in width develop in the pavement surface within the one-year warranty period, the cracking shall be reviewed and evaluated by the Engineer or designated representative before corrective action is taken.

2. **Stability:** Stability test results shall be used as indicators of potential problems. Where stability test results fall below the range specified in this specification, additional tests shall be taken as directed by the Engineer or designated representative for further evaluation and monitoring of the paving mixture. This additional stability testing will be at the expense of the Contractor. When, in the opinion of the Engineer or designated representative, the stability is deemed unacceptable for the intended use of the pavement, the paving mixture shall be removed and replaced to the limits indicated by test results or may be left in place on conditions acceptable to the Engineer or designated representative. When the paving mixture is removed and replaced, it shall be at the sole expense of the Contractor.
3. **Laboratory Density:** Laboratory density results as determined by TxDOT Test Method Tex-207-F shall be used as indicators of potential problems. Where laboratory density test results are less than 94.5% or more than 97.5% of mix design maximum density, additional tests shall be taken as directed by the Engineer or designated representative for further evaluation and monitoring of the paving mixture. This additional laboratory density testing will be at the expense of the Contractor. When, in the opinion of the Engineer or designated representative, the laboratory density is deemed unacceptable for the intended use of the pavement, the paving mixture shall be removed and replaced to the limits indicated by test results.

The removal and replacement of the paving mixture shall be at the sole expense of the Contractor.

4. **Limited Areas:** Irrespective of an acceptable overall Paving Project average for any or all of the Pay-Adjustment Acceptance Factors, limited substandard portions of the Work, as determined by the Engineer or designated representative, shall be remedied or removed and replaced to the satisfaction of the Engineer or designated representative at the sole expense of the Contractor.
- B. **Pay-Adjustment Acceptance Factors:** Contract unit prices shall be adjusted for paving mixtures that fail to meet acceptance criteria for gradation, asphalt content, density and mat thickness in accordance with the following:

Gradation Acceptance Schedule (TEX-210-F)

Sieve	Deviation From Job Mix Formula		Percent Contract Unit Price Reduction
	Daily Average	Overall Average	
Total retained on No. 10 (2.00 mm)	±6.5 6.6±	±5.0 5.1±	0 10
Passing No. 200 (75 µm)	±3.9 4.0±	±3.0 3.1±	0 5

Asphalt Content Acceptance Schedule (TEX-210-F, Part II)

Deviation from the Job Mix Formula	Percent Contract Unit Price Reduction
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Daily Average	Overall Average	Local Streets*	All Others
±0.5	±0.4	0	0
±0.51 to ±0.60	±0.41 to ±0.50	15	25
+0.61 to +0.70	+0.51 to +0.60	25**	100; Remove and Replace
-0.61 to -0.70	-0.51 to -0.60	100: Remove and Replace	100; Remove and Replace
Over ±0.70	Over ±0.60	100: Remove and Replace	100; Remove and Replace
*A local or residential street that serves as access to residence or other abutting property.			
**If the street has an ADT of 500, or less, with 1%, or less, of truck traffic, plus a 2 year warranty; otherwise, Remove and Replace			

Density Acceptance Schedule (TEX-207-F/TEX-227-F)

*Percent Density		Percent Contract Unit Price Reduction	
Daily Average	Overall Average	1½" (38 mm) Thickness or Greater	Less than 1½" (38 mm) Thickness
Above 96.5	Above 96	100; Remove and Replace	100; Remove and Replace
90.5 to 96.5	91 to 96	0	0
90.5 to 87.6	90.9 to 88.1	0.625 per 0.10% deficiency in density	0.50 per 0.10% deficiency in density
Less than 87.6	Less than 88.1	100: Remove and Replace	100; Remove and Replace
*Core bulk density divided by max. theoretical density			

Thickness Acceptance Schedule

Variance Percent of Thickness		Percent Contract Unit Price Reduction
Daily Average	Overall Average	
0—15.0	0—10	0
15.1—20.0	10.1—16	20
20.1—30.0	16.1—25	50
Over 30.0	Over 25	100; Remove and Replace or mill/overlay 1" (25 mm) minimum

The Density Acceptance Schedule For Irregularly Shaped Areas; Hike And Bike Trails And Utility Trenches (see following table) will apply to utility trenches of widths less than 4 feet (1.2 meter) and to irregular shaped areas and hike and bike trails in which an appropriate rolling pattern cannot be established making it difficult to achieve compaction.

Density Acceptance Schedule For Irregularly Shaped Areas; Hike And Bike Trails and Utility Trenches (TEX-207-F/TEX-227-F)

*Percent Density	Percent Contract Unit Price Reduction	
Daily Average	1½" (38 mm) Thickness or Greater	Less than 1½" (38 mm) Thickness
Above 96.5	100; Remove and Replace	100; Remove and Replace
96.5 to 89.0	0	0
89.0 to 86.1	0.625 per 0.10% deficiency in density	0.50 per 0.10% deficiency in density
Less than 86.1	100: Remove and Replace	100; Remove and Replace
*Core bulk density divided by maximum theoretical density		

The Density Acceptance Schedule will apply to utility trenches 4 feet (1.2 meter) or wider.

Core thicknesses greater than Drawing requirements shall be factored into the average thickness calculation as the Drawing required thickness. If total thickness of lift(s) proves to be less than required, the Contractor may remove and replace the overlay deficient areas as agreed to by the Engineer or designated representative. Overlays to correct thickness deficiencies shall be not less than one (1) inch (25-mm) thick. Overlays shall require milling of the asphalt in order to prevent a "featheredge" of the overlaying pavement.

The extent of the area to be overlaid or removed and replaced shall be determined by additional cores with thicknesses greater than or equal to the required thickness. All additional coring that is necessary to determine the area shall be paid for by the Contractor.

340S.13 Measurement

Work performed and material placed shall be measured under one of the following methods. When Drawing quantity measurement is specified, adjustment of quantity may be made as follows. If the quantity measured as outlined vary from those shown on the Drawings by more than 5%, either party to the Contract may request in writing and adjustment of the quantity by each separate bid item. The party to the Contract which requests the adjustment shall present to the other party one copy of measurements and calculations showing the revised quantity in question. This revised quantity, when approved by the Engineer or designated representative, shall constitute the final quantity for which payment will be made. However, no adjustment will be made for any quantity, which exceeds the Drawing required thickness.

- A. Method A: Asphaltic concrete pavement shall be measured by the ton (2,000 pounds) of the type actually used in completed and accepted Work in accordance with the Drawings and specifications.

The measurement shall be made on approved truck scales that meet the requirements of the National Institute of Standards and Technology Handbooks 44 and 112 except that the required accuracy shall be 0.4 percent of the load being weighed. The Contractor shall furnish a report of calibration from a scale mechanic licensed by the Texas Department of Agriculture certifying that the scales meet this requirement.

- B. Method B: Asphaltic concrete pavement shall be measured by the square yard of specified total thickness of the type of paving mixture actually used in completed and accepted Work in accordance with Drawings and specifications. Multiple lifts of the same type shall be considered as one for square yard measurement purposes.
- C. Method C: Asphaltic concrete pavement shall be measured by the lineal foot of specified total thickness of the type of paving mixture actually used in completed and accepted Work in accordance with Drawings and specifications. Multiple lifts of the same type shall be considered as one for linear foot measurement purposes.

340S.14 Payment

Work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit bid prices or pay adjusted unit price for Hot Mix Asphaltic Concrete Pavement, of the types and thicknesses specified. The unit bid prices shall include full compensation for furnishing all labor, equipment, time, materials and incidentals necessary to complete the Work.

Removal of existing hot mix asphalt concrete transition areas prior to overlay, tack coat, saw cutting and temporary pavement markings will not be measured or paid for directly but shall be included in the unit price bid for Standard Specification Item No. 340S, "Hot Mix Asphaltic Concrete Pavement."

Payment for Work meeting these specifications will be made under one of the following:

Pay Item No. 340S-A:	Hot Mix Asphaltic Concrete Pavement, Type ____,	Per Ton
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Pay Item No. 340S-B:	Hot Mix Asphaltic Concrete Pavement, ___ inches, Type ___.	Per Square Yard.
Pay Item No. 340S-C:	Hot Mix Asphaltic Concrete Pavement, ___ Inches, Type ___.	Per Lineal Foot.
Pay Item No. 340S-PQ:	Hot Mix Asphaltic Concrete Pavement, ___ Inches, Type ___, Plan Quantity	Per Ton.
Pay Item No. 340S-L:	Hot Mix Asphaltic Concrete Pavement, ___ in., Type ___, Level-up Course.	Lump Sum
Pay Item No. 340S-M:	Crack Sealing Mobilization,	Lump Sum
Pay Item No. 340S-S:	Crack Sealing,	per Lineal Foot

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Special Specification Item 340S, "Hot Mix Asphaltic Concrete Pavement"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 307S	Tack Coat
Item No. 313S	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-106E	Method of Calculating the Plasticity Index of Soils
Tex-107E	Determination of Bar Linear Shrinkage of Soils
Tex-200-F	Sieve Analysis of Fine and Coarse Aggregates
Tex-203-F	Sand Equivalent Test
Tex-204-F	Design of Bituminous Mixtures
Tex-207-F	Determination of Density of Compacted Bituminous Mixtures
Tex-208-F	Test for Stabilometer Value of Bituminous Mixtures
Tex-210-F	Determination of Asphalt Content of Bituminous Mixtures by Extraction
Tex-212-F, Part II	Determination of Moisture Content of Bituminous Mixtures (by oven drying)
Tex-217-F	Determination of Deleterious Material and Decantation Test For Coarse Aggregates
Tex-227-F	Theoretical Maximum Specific Gravity of Bituminous Mixtures
Tex-410-A	Abrasion of Coarse Aggregate Using the Los Angeles Machine
Tex-460-A	Determination of Crushed Face Particle
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 340	Hot Mix Asphalt Concrete Pavement

RELATED CROSS REFERENCE MATERIALS	
<u>Special Specification Item 340S, "Hot Mix Asphaltic Concrete Pavement"</u>	

<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 206S	Asphalt Stabilized Base
Item No. 210S	Flexible Base
Item No. 306S	Prime Coat
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 320S	Two Course Surface Treatment
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-215-F	Determination of Asphalt Content of Rock Asphalt By Hot Solvent Method
Tex-224-F	Determination of Flakiness
Tex-400-A	Method of Sampling Stone, Gravel, Sand and Mineral Aggregates
Tex-411-A	Soundness of Aggregate by Use of Sodium Sulfate or magnesium Sulfate
Tex-438-A	Accelerated Polish Test for Aggregate

ITEM NO. 360S CONCRETE PAVEMENT 9-26-12

360S.1 Description

This item shall consist of a pavement and/or base of Portland Cement concrete, with or without reinforcement as indicated on the Drawings, with or without monolithic curbs, constructed as herein specified, on prepared subgrade or base course in conformity with the thickness and typical cross sections indicated on the Drawings. Concrete to be considered of satisfactory quality provided it is made (a) of materials accepted for job, (b) in the proportions established by the Contractor and (c) mixed, placed, finished and cured in accordance with the requirements of this specification.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

P360S.2 Submittals

The submittal requirements of this specification item may include:

- A. Mix design option(s) of the class of concrete required on the project,
- B. The supplier of the concrete mix design(s) and type of mixing equipment, and
- C. Type of admixtures to be used with the concrete mixes.

360S.3 Materials

A. Cementitious Materials

Portland cement shall conform to ASTM C 150, Type I (General Purpose) and Type III (High Early Strength). Type III cement shall be used when high early strength concrete is indicated on the Drawings. If the use of high early cement is not specified and the Contractor desires to use it, the Contractor shall obtain written permission from the Engineer or designated representative prior to its use and shall assume all additional costs incurred by the use of such cement. All cement shall be of the same type and from the same source for a project unless written permission is first received from the Engineer or designated representative.

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the United States Environmental Protection Agency (USEPA). Supplier shall provide current TCEQ and EPA authorizations to operate the facility.

Bulk or sacked cement may be used and a bag shall contain 94 pounds (42.6 KG) net. All bags shall be in good condition at the time of inspection. Bulk cement shall be weighed on approved scales as herein prescribed.

All cement shall be stored in a suitable weather tight building or bin, which will protect the cement from dampness. The cement shall be so stored as to provide easy access for proper inspection. Any cement, which has become partially set or which contains hard lumps or cakes or cement salvaged from discarded or used bags, shall not be used.

Fly ash (denoted by Texas DOT designations Type A and Type B) may replace 20 to 35 percent of a mix design's Portland cement content by absolute volume. Fly ash shall not be used in mix designs with less than 5 sacks of Portland cement per cubic yard [six and a half (6.5) sacks of Portland cement per cubic meter]

unless specifically permitted by the Contract plans of project manual. Fly ash shall conform to the requirements of Item No. 405S, "Concrete Admixtures."

B. Admixtures

Concrete admixtures conforming to Item No. 405S, "Concrete Admixtures" may be used when approved by the Engineer or designated representative to minimize segregation, improve workability, reduce the amount of mixing water and to provide normal hot weather concreting provisions. The use of admixtures shall not alter the approved mix designs, except for water content.

C. Coarse Aggregate

Coarse aggregate shall consist of durable particles of gravel, crushed blast furnace slag and/or crushed stone of reasonably uniform quality throughout, free from injurious amounts of salt, alkali, vegetable matter or other objectionable material, either free or as an adherent coating on the aggregate. It shall not contain more than 0.25 percent by weight of clay lumps nor more than 1.0 percent by weight of shale nor more than 5.0 percent by weight of laminated and/or friable particles when tested in accordance with TxDOT Test Method Tex-413-A.

Coarse aggregate shall have a wear of not more than 45 percent when tested according to TxDOT Test Method Tex-410-A and when tested by standard laboratory methods shall meet the following grading requirements:

Retained on 1¾ inch (43.75 mm) sieve	0%
Retained on 1½ inch (37.5 mm) sieve	0 to 5%
Retained on ¾ inch (19.0 mm) sieve	30 to 65%
Retained on ⅝ inch (9.5 mm) sieve	70 to 90%
Retained on No. 4 (4.75 mm) sieve	95 to 100%

Loss by Decantation TxDOT Test Method *Tex-406-A. 1.0% Maximum

* In the case of aggregate made primarily from crushing of stone. If the material finer than the 200 sieve is definitely established to be the dust of fracture essentially free from clay or shale as established by Part III of TxDOT Test Method Tex-406-A, the percent may be increased to 1.5.

When the plans do not require a monolithic pour of curb or curb and gutter, the Contractor may elect to use the following gradation of coarse aggregate for curb or curb and gutter:

Retained on 1½ inch (37.5 mm) sieve	0%
Retained on ¾ inch (9.5 mm) sieve	5 to 30%
Retained on No. 4 (4.75 mm) sieve	75 to 100%

Where the coarse aggregate is delivered on the job in 2 or more sizes or types, each type and/or size shall be batched and weighed separately.

All aggregates shall be handled and stored in such a manner as to prevent size segregation and contamination by foreign substances and maintain as nearly as possible in a uniform condition of moisture. When segregation is apparent, the aggregate shall be remixed with suitable equipment as required. At time of its use, the aggregate shall be free from frozen material and aggregate containing foreign materials will be rejected. Coarse aggregate that contains more than 0.5 percent free moisture by weight shall be stockpiled for at least 24 hours prior to use.

Adequate storage facilities shall be provided for approved materials. The intermixing of non-approved materials with approved materials either in stockpiles or in bins will not be permitted. Aggregates from

different sources shall be stored in different stockpiles unless otherwise approved by the Engineer or designated representative.

D. Fine Aggregate

Fine aggregate shall be free from injurious materials of salt, alkali or vegetable matter. It shall not contain more than 0.5 percent by weight of clay lumps. When subjected to the color test for organic impurities, TxDOT Test Method Tex-408-A, the fine aggregate shall not show a color darker than standard.

Unless shown otherwise on the drawings, fine aggregate shall have an acid insoluble residue of at least 60% by weight when tested in accordance with Tex 612-J.

Unless specified otherwise, fine aggregate shall meet the following grading requirements:

Retained on 3/8 inch (9.5 mm) sieve	0%
Retained on No. 4 (4.75 mm) sieve	0 to 5%
Retained on No. 8 (2.36 mm) sieve	0 to 20%
Retained on No. 16 (1.185 mm) sieve	15 to 30%
Retained on No. 30 (600 µm) sieve	35 to 75%
Retained on No. 50 (300 µm) sieve	70 to 90%
Retained on No. 100 (150 µm) sieve	90 to 100%
Retained on No. 200 (75 µm) sieve	97 to 100%

Fine aggregate will be subjected to the Sand Equivalent Test, TxDOT Test Method Tex-203-F. The sand equivalent value shall not be less than 80.

E. Mineral Filler

Mineral filler shall consist of clean stone dust, crushed sand, crushed shell or other approved inert material. It shall meet the following requirements when tested in accordance with TxDOT Test Method Tex-401-A:

Retained on No. 30 (600 µm) sieve	0%
Retained on No. 200 (75 µm) sieve	0 to 35%

Where fine aggregate is delivered to the job in 2 or more sizes or types, each type and/or size of material shall be batched and weighed separately. Where mineral filler is used, it shall be batched and weighed separately. At the time of its use the fine aggregate shall be free from frozen material and aggregate containing foreign material will be rejected.

All fine aggregate shall be stockpiled for at least 24 hours prior to use.

F. Mixing Water

Water for use in concrete and for curing shall be free from oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl nor more than 1,000 parts per million of sulfates as SO₄.

Water from municipal supplies approved by the State Health Department will not require testing. Contractor shall sample and test water from other sources and submit test results to the Engineer or designated representative for approval 10 days prior to proposed use.

Tests shall be made in accordance with "Standard Method of Test for Quality of Water to be used in Concrete," AASHTO Method T-26.

G. Transit-mixed Concrete

The use of transit-mixed (ready-mixed) concrete will be permitted by the Engineer or designated representative provided the batching plant and mixer trucks meet requirements of quality specified herein.

When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the drum of the mixer or agitator truck. Delivery of concrete to the site of the work and its discharge from the truck mixer, agitator or non-agitating equipment shall be in accordance with the requirements of Item No. 410S, "Concrete Structures."

Ready-mixed concrete, batching plant and mixer truck operation shall include the following:

1. A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of the concrete batch, weight of cement, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on the ticket may be cause for rejection of the concrete.
2. Sufficient trucks will be available to support continuous slab placements. The Contractor will satisfy the Engineer or designated representative that adequate standby trucks are available to support monolithic placement requirements.
3. A portion of the mixing water, required by the batch design to produce the specified slump, may be withheld and added at the job site but only with the permission of the Engineer or designated representative and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken.

H. Joint Sealer

Unless otherwise shown on the plans, joint sealant for concrete pavement used on airport runways and/or taxiways shall be TxDOT Class 5. All other joint sealant shall be TxDOT Class 2.

As a minimum, the joint sealant shall comply with the following. The manufacturer of the joint sealant shall furnish certification that the product to be supplied meets or exceeds the specification.

1. Class 2 (Hot Poured Rubber-Asphalt). This sealer shall conform to Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)". The sealer must be compatible with asphaltic concrete.
2. Class 5 (Low Modulus Silicone Sealant for Concrete Pavement). This material shall conform to Item 413S, "Cleaning and/or Sealing Joints and Cracks (PCC)" and shall be furnished in a one-part silicone formulation, which does not require a primer for bond to concrete. A backer rod shall be required which will be compatible with the sealant. No bond or reaction shall occur between the rod and sealant. The sealant shall adhere to the sides of the concrete joint. It shall not crack or break when exposed to temperatures below 32°F (0°C).

The sealant material shall have the following properties:

Color	Gray
Flow, MIL-2-8802D, Sec 4.8.4, max	0.2
Working time, minutes	10
Tack-free time at 77°F ±2°F (25°C ±1.1°C), MIL-2-8802D	
Sec 4.8.7, minutes	60
Cure time at 77°F (25°C), days	7—14
Full Adhesion, days	14—21

As Cured - after 7 days at 77°F (25°C) and 40% Relative Humidity

Elongation, minimum percent	1200
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Durometer Hardness, Shore A, ASTM D 2240, min	15
Joint movement capability, percent	+100/-50
Tensile Strength, maximum elongation, percent	100
Peal strength, psi	25 (172 kPa)

I. Backer Rod

Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement.

J. Joint Filler

Boards for expansion joint filler and for contraction and longitudinal joints shall be of the size, shape and type indicated.

Board shall be obtained from Redwood, Cypress, Gum, Southern Yellow Pine or Douglas Fir timber. They shall be solid heartwood and shall be free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler. With the exception of Redwood and Cypress, all boards shall have a creosote or pentachlorophenol treatment of 6 pounds per cubic foot (96 kg/m³). When oven dried at 230°F (110°C) to a constant weight, the weight of the board per cubic foot (minus treatment), shall not be less than 20 pounds nor more than 35 pounds (not less than 320 nor more than 561 kgs per cubic meter).

K. Asphalt Board

Asphalt board when used as indicated shall be of required size, full depth of concrete placement and uniform thickness. When used in transverse joints, it shall conform approximately to shape of the pavement crown as indicated. Asphalt board shall consist of 2 liners of 0.016-inch (0.4 mm) asphalt impregnated paper filled with a mastic mixture of asphalt and vegetable fiber and/or mineral filler. Boards shall be smooth, flat and straight throughout and shall be sufficiently rigid to permit easy installation. Boards that crack or shatter during installing and finishing operations will not be acceptable. Board shall be furnished in lengths equal to ½ the pavement width or in lengths equal to the width between longitudinal joints and may be furnished in strips or scored sheets of the required shape. When tested in accordance with TxDOT Test Method Tex-524-C the asphalt boards shall not deflect from the horizontal more than ¾ inch in 3½ inches (19.3 cm in 90 cm). The asphalt board shall be placed such that they will not interfere with the bonding of the joint sealer.

L. Load Transmission Devices for Expansion and Contraction Joints

Approved load transmission devices, when indicated, shall meet the requirements specified herein:

Smooth steel bar dowels, used when indicated, shall be of the size and type indicated and shall be open-hearth, basic oxygen or electric-furnace steel conforming to the properties specified for grade 60 in ASTM A 615. The free end of dowel bars shall be smooth and free of shearing burrs.

When indicated, one end of each dowel bar shall be encased in an approved cap having an inside diameter of 1/16 inch (16 mm) greater than the diameter of the dowel bar. The cap shall be of such strength, durability and design as to provide free movement of the dowel bar and shall be approved by the Engineer or designated representative prior to use. One end of the cap shall be filled with a soft felt plug or shall be void in order to permit free movement of the dowel bar for a distance equivalent to 150 percent of the width of the expansion joint used. The dowel caps and dowel bars shall be held securely in place by bar ties as indicated on the drawings. Mechanical methods of implanting dowel bars in the plastic concrete may be used when approved by the Engineer or designated representative.

Where required, dowel bars shall be coated with a plastic material meeting the requirements indicated.

Where red lead and oil bar coating is indicated, the red lead may be of any standard commercial grade and the oil shall be clean and no lighter than Standard No. 30 SAE grade. Approved thinner and dryer may be added to the red lead, but the material upon application shall be of such consistency that will provide a uniform and heavy coating on the bar. Where asphalt bar coating is indicated, the material may be any standard grade of oil asphalt and shall be applied hot. Cutback asphalt will not be permitted for bar coating.

M. Metal Installing Devices for Joint Assembly

Metal installing devices for expansion and contraction joint assemblies (such as welded wire bar chairs, bar stakes and marker channels, channel caps, etc.) shall be as indicated or may be similar devices of equivalent or greater strength, approved by the Engineer or designated representative, that will secure joint assembly in correct position during the placing and finishing of concrete. Load transmission devices used in joint assemblies shall be secured in position by a transverse metal brace of the type and design indicated or may be secured in position by other approved devices of equivalent or greater strength that will provide positive mechanical connection between the brace and each unit (or than by wire tie) and prevent transverse movement of each load transmission device.

N. Steel Reinforcement

Steel reinforcing bars as required including tie bars shall be open-hearth, basic oxygen or electric-furnace new billet steel of Grade 60 or Grade 40 for concrete reinforcement as indicated. Bars that require bending shall be Grade 40 conforming to the requirements of ASTM A 615.

High yield reinforcing steel shall be either (a) open-hearth, basic oxygen or electric-furnace new billet steel conforming to ASTM A 615 Grade 60 or (b) rail steel bars for concrete reinforcement, conforming to ASTM A 616 Grade 60. Bars produced by piling method will not be accepted. High yield reinforcing steel bars shall be further identified by a special marking rolled into each bar. All reinforcing steel shall be deformed bars conforming to the requirements of pertinent ASTM Specifications.

Where prefabricated deformed wire mats are indicated or permitted, the wire shall be cold worked deformed steel wire conforming to the requirements of ASTM A 496, except that steel shall be made by open-hearth, electric-furnace or basic oxygen processes. The prefabricated deformed wire mats shall conform to the requirements of ASTM A 497, except that wires used shall be deformed and transverse wires shall project beyond the centerline of each edge longitudinal wire as indicated. Mats that have been bent or wires dislocated or parted during shipping or project handling shall be realigned to within ½ inch (13 mm) of original horizontal plane of the mat. Mats with any portion of the wires out of vertical alignment more than ½ inch (13 mm) after realignment and/or wires dislocated or mutilated so that, in the opinion of the Engineer, they do not represent the original mat, shall be rejected. The reinforcement may be clamped or wired so that the reinforcement will retain the horizontal and vertical alignment as indicated or as approved by the Engineer or designated representative. Deformed wire may be used for tie bars and load transfer bars that require bending. The nominal size, area and theoretical weight of reinforcing steel wires covered by this provision are as listed in Table II. When fabricated steel bars or rod mats are indicated, the mats shall meet requirements of ASTM A 184.

Steel wire fabric reinforcement shall be of the gage and spacing indicated and shall conform to the requirements of ASTM A 82. Longitudinal and transverse wires shall be electrically welded together at all points of intersection and the welds shall be of sufficient strength that they will not be broken during handling or placing. All welding and fabrication of fabric sheets shall conform to the requirements of ASTM A 185. Welded steel wire fabric shall be furnished in sheets as indicated and steel having been previously bundled into rolls will not be accepted. An approved hinge will be permitted in each sheet to provide for each sheet longitudinally. When wire fabric is used, it will replace only the longitudinal and transverse bars. The tie bars and load transmission units at joints will not be affected.

Table II: DIMENSIONAL REQUIREMENTS FOR DEFORMED STEEL WIRE FOR CONCRETE REINFORCEMENT				
Deformed Wire Size No.	Unit Weight Pounds Per Ft. (Kgs per Meter)	Diameter Inches (Centimeters)	Cross-Sectional Area, Sq. Inches (Sq. Centimeters)	Perimeter Inches (Centimeters)
Column 1	Column 2	Column 3	Column 4	Column 5
D-1	0.034 (.051)	0.113 (.287)	0.01 (.06)	0.355 (.902)
D-2	0.068 (.101)	0.159 (.404)	0.02 (.13)	0.499 (1.267)
D-3	0.102 (.152)	0.195 (.495)	0.03 (.19)	0.612 (1.554)
D-4	0.136 (.202)	0.225 (.572)	0.04 (.26)	0.706 (1.793)
D-5	0.170 (.253)	0.252 (.640)	0.05 (.32)	0.791 (2.009)
D-6	0.204 (.304)	0.276 (.701)	0.06 (.39)	0.867 (2.202)
D-7	0.238 (.354)	0.296 (.752)	0.07 (.45)	0.936 (2.377)
D-8	0.272 (.405)	0.319 (.810)	0.08 (.52)	1.002 (2.545)
D-9	0.306 (.455)	0.338 (.859)	0.09 (.58)	1.061 (2.695)
D-10	0.340 (.506)	0.356 (.904)	0.10 (.65)	1.118 (2.840)
D-11	0.374 (.557)	0.374 (.950)	0.11 (.71)	1.174 (2.982)
D-12	0.408 (.607)	0.390 (.991)	0.12 (.77)	1.225 (3.112)
D-13	0.442 (.658)	0.406 (1.031)	0.13 (.84)	1.275 (3.239)
D-14	0.476 (.708)	0.422 (1.072)	0.14 (.90)	1.325 (3.366)
D-15	0.510 (.759)	0.437 (1.110)	0.15 (.97)	1.372 (3.485)
D-16	0.544 (.810)	0.451 (1.146)	0.16 (1.03)	1.416 (3.600)
D-17	0.578 (.860)	0.465 (1.181)	0.17 (1.10)	1.460 (3.708)
D-18	0.612 (.911)	0.478 (1.214)	0.18 (1.16)	1.501 (3.813)
D-19	0.646 (.961)	0.491 (1.247)	0.19 (1.23)	1.542 (3.917)
D-20	0.680 (1.012)	0.504 (1.280)	0.20 (1.29)	1.583 (4.021)
D-21	0.714 (1.063)	0.517 (1.313)	0.21 (1.35)	1.624 (4.125)
D-22	0.748 (1.113)	0.529 (1.344)	0.22 (1.42)	1.662 (4.221)
D-23	0.782 (1.164)	0.541 (1.375)	0.23 (1.48)	1.700 (4.318)
D-24	0.816 (1.214)	0.553 (1.405)	0.24 (1.55)	1.737 (4.412)
D-25	0.850 (1.265)	0.564 (1.433)	0.25 (1.61)	1.772 (4.500)
D-26	0.884 (1.316)	0.575 (1.461)	0.26 (1.68)	1.806 (4.587)
D-27	0.918 (1.366)	0.586 (1.488)	0.27 (1.74)	1.841 (4.676)
D-28	0.952 (1.417)	0.597 (1.516)	0.28 (1.81)	1.876 (4.765)
D-29	0.986 (1.467)	0.608 (1.544)	0.29 (1.87)	1.910 (4.851)
D-30	1.020 (1.518)	0.618 (1.570)	0.30 (1.94)	1.942 (4.933)
D-31	1.054 (1.569)	0.628 (1.595)	0.31 (2.00)	1.973 (5.011)

O. Polyethylene Film

Polyethylene film shall be opaque pigmented white in color and shall be manufactured from virgin resin without additives or scrap. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The film shall have a minimum thickness of 4 mils (0.004 inch), shall have a minimum tensile strength of 1,700 psi at 77°F (11,720 kPa at 25°C) in the longitudinal direction and 1,200 psi at 77°F (8,275 kPa at 25°C) in the transverse direction and shall have a minimum elongation of 200 percent at 77°F (25°C) in the longitudinal direction and 150 percent at 77°F (25°C) in the transverse direction. The permissible percent moisture loss shall not exceed 2 percent after 24 hours and 4 percent after 72 hours. Tests for tensile

strength and elongation will be conducted in accordance with ASTM Designation: D 882, Method A. Tests for moisture retention will be conducted in accordance with ASTM Designation: C 156.

P. Membrane Curing Compound

Membrane curing compound shall conform to Item No. 409S, "Membrane Curing," Type 2 white pigmented.

Q. Asphalt Curing

Where asphalt is to be placed on a concrete base, asphalt shall be used for curing concrete base, the material shall conform to Item No. 301S, "Asphalts, Oils and Emulsions" for RS-2 or RS-2h or as indicated on the drawings.

360S.4 Equipment

A. General

All equipment necessary for construction of this item shall be on the Project and shall be approved by Engineer or designated representative as to conditions before the Contractor will be permitted to begin construction operations on which the equipment is to be used. When approved by the Engineer or designated representative in writing, a commercial or independently operated batching plant for measuring materials outside limits of the project may be used.

B. Mixer

The mixer furnished may be either a paving mixer (operated at site of construction or centrally located), a stationary mixer (central mixer) or a paving mixer (truck mounted) that will produce adequately mixed concrete meeting the specified requirements. The mixer, or mixers, shall conform to the following requirements:

1. Each mixer shall have attached in a prominent place a manufacturer's plate showing rated capacity of the drum in terms of volume of mixed concrete and the recommended speed of rotation of the mixing drum or blades.
2. The stationary mixer (central mixer) or truck mounted paving mixer shall be operated at the manufacturer's recommended speed.
3. The size of the paving mixer shall not be less than that of a 27-E paver, as established by the Mixer Manufacturer's Bureau of Associated General Contractors. The paving mixer shall be operated at a drum speed of not less than 16 revolutions per minute and not more than 22 revolutions per minute. Pickup and throw over blades in the drum of the mixer shall be replaced when worn down 3/4 inch (19 mm) or more.
4. Each truck mounted paving mixer shall be approved by the Engineer or designated representative prior to use on the project. It shall be classified as a "paving mixer" by the manufacturer and shall be so designed that a uniform and low slump concrete (approximately 1½ inch [38 mm] slump) can be mixed without aggregate size segregation. The mixer shall be capable of discharging the low slump concrete at a speed of 10 seconds per cubic yard (13 seconds per cubic meter) or faster.
5. Each mixer shall be equipped with an approved automatic device for satisfactorily timing the mix and locking the discharging device in order to prevent the discharging of the mixer before the end of the required mixing period. This timing device shall operate a sounding device to signal plainly the completion of the mixing time. When permitted by the Engineer a light signal device may be used.
6. Multiple drum mixers will be permitted provided their operation is properly synchronized. The mixing time shall be determined exclusive of the time required to transfer concrete from one drum to the next drum.

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7. Each mixer shall be equipped with a water-measuring device so constructed that it will measure the water within 1 percent of the total amount required for each batch. Unless the water is to be weighed, the water measuring equipment shall include an auxiliary tank with a capacity greater than that of the measuring tank and from which the measuring tank will be filled by gravity flow. The measuring tank shall be open to the atmosphere and shall be so placed and constructed that the water for a batch can be discharged into a calibrated tank or weighing device for checking the accuracy of water measurement without seriously delaying the paving operations. The Contractor shall have a calibrated tank or weighing device available at all times at a location satisfactory to the Engineer or designated representative.
 8. If a paving mixer is furnished and operated at the site of construction, it shall be equipped with a power controlled boom and bucket, so designed as to permit uniform distribution of the concrete for the full width between pavement forms. Alternate equipment for distributing concrete may be substituted when approved by the Engineer in writing, provided uniform distribution is obtained without segregation.
 9. If central mixed concrete is used on the project, the Contractor shall provide equipment designed to provide uniform distribution for the concrete for the full width between pavement forms without segregation.

C. Transit-mix Trucks

When transit-mix (ready-mix) concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to the batch to coat the drum of the mixer or agitator truck. This shall be required for every load of concrete. The mixing speed shall be attained as soon as all ingredients are in the mixer. Each complete batch (containing all the required ingredients) shall be mixed not less than 70 nor more than 100 revolutions of the drum at mixing speed.

A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with permission of the Engineer and under the Engineer's supervision. When water is added at the job site, 25 revolutions (minimum) at mixing speed, will be required to flush down the blades after charging shall be accurately measured and included in the quantity of mixing water. The introduction of the initial mixing water, except blade wash down water and that permitted in this Article shall be prior to or simultaneous with the charging of the aggregates and cementitious material.

Mixing and agitating speed shall be as designated by the mixer manufacturer. All revolutions after prescribed mixing shall be at agitating speed. Except for short periods of time during discharge, the drum shall be kept in continuous motion from the time the mixing is started until the discharge is completed.

Additional mortar, consisting of 1 sack cement, 3 parts sand and sufficient water, shall be added to the batch to coat the drum of the transit mixer or agitator truck. This shall be required for every load of concrete.

The loading of transit-mixers shall not exceed 63 percent of the drum volume. When used as an agitator only, the loading of truck mixers shall not exceed 80 percent of the drum volume.

The batching plant and transit-mix trucks shall operate under the following system:

1. A ticket system will be used that includes a copy for the construction inspector. The ticket will have machine stamped time/date of water/cement batch; weight of cement, fly ash (if applicable), water, sand and aggregates; exact nomenclature and quantities of admixture. Any item missing or incomplete on the ticket will be cause for rejection. Coded readouts may be used if approved in advance by the Engineer.
2. Sufficient trucks will be available to support continuous placements. The Contractor will satisfy the Engineer that adequate standby trucks are available to support monolithic placement when required.

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3. A portion of the mixing water, required by the batch design to produce the desired slump, may be withheld and added at the job site, but only with the permission of the Engineer and under the Inspector's observation. When water is added under these conditions, it will be thoroughly mixed before any slump or strength samples are taken.

D. Hauling Equipment

Batch hauling equipment for the transportation of measured materials from the batching plant to the mixer shall be equipped with tight covers, which shall be used to prevent excessive evaporation of moisture or any loss of material.

If a central mixer is used, concrete may be transported to the point of delivery in truck agitators or non-agitating trucks.

If a truck mounted paving mixer is used, it may be used to transport the concrete after mixing is complete.

If non-agitator trucks are used they shall conform to the following requirements:

The bed of non-agitating hauling equipment shall be a smooth, mortar-tight, metal container. The hauling equipment shall be capable of delivering the concrete to the work site in a thoroughly mixed and uniform mass and capable of discharging the concrete at a satisfactory controlled rate without segregation. If in the opinion of the Engineer any appreciable segregation or accumulation of excess water and/or mortar occurs on the surface of the concrete, this may be cause for rejection and this method of transporting the concrete to the point of delivery shall be suspended as directed by the Engineer.

E. Subgrade or Subbase Planer and Templates

Unless a stabilized subbase is provided, an approved subbase planer shall be provided, mounted on visible rollers riding on the forms and having adjustable cutting blades which shall trim the subgrade to the exact section as indicated. The planer frame shall be heavy enough to remain on the forms at all times and shall be of such strength and rigidity that, under a test made by changing the support from the wheels to the center, it shall not develop a deflection for more than $\frac{1}{8}$ inch (3 mm). Tractive power equipment used to pull the planer shall not be such as to produce ruts or indentations in the subgrade.

When the slip form method of paving is to be used, the subgrade planer will be operated on a prepared track grade or controlled by an electronic sensor system operated from a string line that establishes the horizontal alignment and the elevation of the subbase.

A template for checking the contour of the subbase shall be provided and operated by the Contractor. The template shall rest upon the side forms and shall be of such strength and rigidity that, under a test made by changing the support to the center, it shall not show a deflection of more than $\frac{1}{8}$ inch (3 mm). It shall be provided with accurately adjustable rods projecting downward to the subgrade at 1-foot (30 cm) intervals and these rods shall be adjusted to the required cross section of the bottom of the slab when the template is resting upon the side forms. Where stabilized subbase is provided, use of a scratch template will be required.

F. Forms

Side forms shall be of metal of approved cross section. The preferred depth of the form shall be equal to the required edge thickness of the pavement. Forms with depth greater than the required edge thickness of the pavement will be permitted.

The length of form sections shall not be less than 10 feet (0.3 meters) and each section shall provide for staking in position with not less than 3 pins. Flexible or curved forms of wood or metal of proper radius shall be used for curves of 200-foot (61 meter) radius or less. Forms shall be of ample strength and shall be provided with adequate devices for secure setting so that when in place they will withstand, without visible springing or settlement, the impact and vibration of the spreading and finishing machinery. In no case shall the base be less than 6 inches (15.2 cm) for a form 6 inches (15.2 cm) or more in height. The forms shall be

free from warps, bends or kinks and shall be sufficiently true to provide a reasonably straight edge on the concrete. The top of each form section, when tested with a straightedge shall conform to the requirements specified for the surface of the completed pavement. Sufficient forms shall be provided for satisfactory prosecution of the work.

Outside curb forms shall be of wood or metal of a section satisfactory to the Engineer or designated representative, straight, free of warp and shall be in a depth at least equal to the depth of the curb. They shall be mounted on the paving forms and securely attached thereto and maintained in true position during the placing of the concrete. Inside curb forms, if required, shall be of approved material and of such design as to provide the curb required and shall be rigidly attached to the outside forms.

G. Concrete Spreader

Use of concrete spreader shall be required and it shall be a self-propelled machine having sufficient power and traction to spread and strike off concrete without slippage on the forms. It shall be equipped with a power driven device for spreading the concrete uniformly between the forms. The spreading device may be either a reciprocating blade, a screw conveyer or a belt conveyer. The spreader shall be capable of striking off the surface of the concrete between the forms in the longitudinal direction of the slab at any required elevation.

Mechanically operated concrete spreaders of other designs, which uniformly distribute the concrete with a minimum of segregation, may be used when approved by the Engineer.

H. Slipform Paver

With prior approval, the Contractor may place concrete with slip form paver. This paver shall be equipped with a longitudinal transangular finishing float adjustable to crown and grade and be satisfactory to the Engineer or designated representative. The float shall extend across the pavement practically to the side forms and/or the edge of slab. A "string line" shall be used to provide grade control for the paver.

I. Mechanical Vibratory Equipment

All concrete placed for pavement shall be consolidated by approved mechanical vibrators operated ahead of the transverse finishing machine and designed to vibrate the concrete internally and/or from the surface. Vibratory members shall extend across the pavement practically to, but shall not come in contact with the side forms. Mechanically operated vibrators shall be mounted in such manner as not to interfere with transverse or longitudinal joints. The internal-type vibrators shall be spaced at not more than 24 inches (61 cm) and shall be equipped with synchronized vibratory units. Separate vibratory units shall be spaced at sufficiently close intervals to provide uniform vibration and consolidation to the entire width of the pavement. The frequency in air of the interval spud type vibratory units shall be not less than 8,000 cycles per minute and not less than 5,000 cycles per minute for tube types and the method of operation shall be as directed by the Engineer or designated representative. The Contractor shall have a satisfactory tachometer available for checking vibratory the elements.

The pavement vibrators shall not be used to level or spread the concrete but shall be used only for purposes of consolidation. The vibrators will not be operated where the surface of the concrete, as spread, is below the elevation of the finished surface of the pavement, except for the first lift of concrete where double strike off method of placement is employed and the vibrators shall not be operated for more than 15 seconds while the machine upon which they are installed is standing still.

The pan type vibratory units shall apply the vibrating impulses directly to the surface of the concrete. The operating frequency shall be not less than 3,500 cycles nor more than 4,200 cycles per minute in air. The Contractor shall have a satisfactory tachometer available for checking the speed of the vibratory elements.

Approved hand manipulated mechanical vibrators shall be furnished in the number required for provision of proper consolidation of the concrete along forms, at joints and in areas not covered by mechanically

controlled vibrators. These vibrators shall be sufficiently rigid to insure control of the operating position of the vibrating head.

Complete and satisfactory consolidation of the concrete pavement is a most important requirement of this specification. Cores taken shall be carefully examined for voids, honeycombing or other evidence of incomplete consolidation. If such evidence is present, changes in the consolidation procedures and/or equipment will be made to insure satisfactory consolidation.

J. Finishing Equipment

1. Transverse Finishing Machine

The Transverse finishing machine shall be provided with 2 screeds accurately adjusted to the crown of the pavement, shall be self-propelled and mounted in a substantial frame equipped to ride on the forms, or may be slip form finished, and shall be so designed and operated as to strike off and consolidate the concrete.

2. Longitudinal Finishing

A transverse drag float may be used in lieu of the longitudinal finishing machine with the Engineer's approval. Finishing machines shall be maintained in a tight and good operating condition, accurately adjusted to the required crown or profile and free from deflection, wobble or vibration tending to affect the precision of finish. Machines failing to meet these requirements will be rejected by the Engineer or designated representative and the Contractor shall provide approved equipment.

Where hand finishing is permitted under this specification, the Contractor shall provide a strike template and a tamping template both of 4 by 10 inch (10 by 25 cm) lumber or equivalent metal section and at least 2 feet longer than the width of the pavement. Both templates to conform to the crown section of the pavement and the tamp, if of wood, shall have a steel face not less than $\frac{3}{8}$ inch (9.5 mm) in thickness. The Contractor shall also provide a longitudinal float of approved design and not less than 14 feet (4.25 meters) in length.

The Contractor shall furnish and maintain at least two standard 10-foot (3.05 meter) steel straightedges on the work site at all times during the paving operations. The Contractor shall operate same in the presence of the Engineer or designated representative.

The Contractor shall furnish a sufficient number of bridges to ride on the forms and span the pavement for finishing operations and for the installation and finishing of joints. All necessary finishing and edging tools shall be furnished as may be required to complete the pavement as indicated.

360S.5 Proportioning of Concrete

A. Proportions

Concrete shall be composed of Cementitious Materials, fine aggregate, coarse aggregate, mineral filler and/or admixture if used and water, mixed in the proportions designated by the approved Mix Design and in the manner set forth in this specification. On the basis of job and laboratory investigations of the proposed materials, the Contractor will fix proportions by weight of water, coarse aggregate, fine aggregate, cementitious materials, admixture and mineral filler where required, in order to produce concrete of the specified strength and workability for the actual delivery time and site conditions to be encountered. Where curbs are placed separately, the Engineer or designated representative may allow aggregate gradation conforming to Class A Concrete, Item No. 403, "Concrete for Structures."

B. Concrete Strength

The concrete mix to be designed to produce a concrete with the following requirements:

Table 1: CONCRETE PAVEMENT		
Item	Test	Value
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal. (liter)/sack, Maximum		6.25 (23.66)
Sacks Cement, Minimum, 94 pounds (42.6 KG) ea		6 per cubic yard (7.85 per cubic meter)
Coarse Aggregate Factor		0.65 min—0.85 max.
Compressive Strength after 7 Days, psi (kPa)	Tex-418-A	4000 (27,600)
Compressive Strength after 28 Days, psi (kPa)	Tex-418-A	4500 (31,000)
Maximum Concrete Mix Temperature °F (°C)		95 (35)
Retarder: Regular Concrete increase in time over 360S.7(3), minutes, Maximum	60	

Table 2: HIGH EARLY STRENGTH CONCRETE		
Item	Test	Value
Cement Type		III
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio gal. (liter)/sack, Maximum		6.25 (23.66)
Sacks Cement, Minimum, 94 pounds (42.6 KG) ea		7 per cubic yard (9.16 per cubic meter)
Coarse Aggregate Factor		0.65 min-0.85 max
Slump, inches (Centimeters)	Tex-415-A	½ to 2 (1.25 to 5.0)
Compressive Strength, after 24 hours, psi (kPa)	Tex-418-A	2,100 (14,500)
Compressive Strength, after 3 Days, psi (kPa)	Tex-418-A	2,750 (19,000)
Compressive Strength, after 7 Days, psi (kPa)	Tex-418-A	4,500 (31,000)
Compressive Strength, after 28 Days, psi (kPa)	Tex-418-A	4,925 (34,000)
Maximum Concrete Mix, Temperature °F (°C)		95 (35)

The Contractor may submit a mix design using high range water reducing admixtures conforming to Item No. 405S, "Concrete Admixtures" in lieu of the concrete pavement mix specified and shall meet the following requirements:

Table 3: HIGH RANGE WATER REDUCING ADMIXTURES: SUPERPLASTER SIZER CONFORMING TO SPECIFICATION ITEM NO. 405S, "CONCRETE ADMIXTURES"		
Item	Test	Value
Entrained Air	Tex-416-A	3 to 6 percent
Water-Cement Ratio, gal. (liter)/sack, Maximum		6.25
Sacks Cement, Minimum, 94 pounds (42.6 KG) ea		6 per cubic yard (7.85 per cubic meter)
Coarse Aggregate Factor		0.65 min.—0.85 max.
Slump, inches (cms) before Admixture	Tex-415-A	½ to 2 (1.25 to 5)
Slump, Inches (cms) after Admixture	Tex-415-A	4 to 10 (2.5 to 25)
Compressive Strength, after 3 Days, psi (kPa)	Tex-418-A	3,125 (21,500)
Compressive Strength, after 7 Days, psi (kPa)	Tex-418-A	4,500 (31,000)
Compressive Strength, after 28 Days, psi (kPa)	Tex-418-A	4,925 (34,000)
Maximum Concrete Mix, Temperature, °F (°C)		100 (37.8)
Retarder, Regular Concrete Over 360S.7C, Minutes, Maximum	120	

Table 4: Over Design Required to Meet Compressive Strength Requirements ¹					
Number of Tests ^{2,3}	Standard Deviation, psi (mPa)				
	300 (20.6)	400 (2.75)	500 (3.44)	600 (4.13)	700 (4.82)
15	470 (3.24)	620 (4.27)	850 (5.85)	1,120 (7.71)	1,390 (9.57)
20	430 (2.96)	580 (3.99)	760 (5.23)	1,010 (6.95)	1,260 (8.67)
30 or more	400 (2.75)	530 (3.65)	670 (4.61)	900 (6.20)	1,130 (7.78)

Notes:

1. When designing the mix, add the tabulated amounts to the minimum design strength in Tables 1, 2 or 3. Maximum water-cement or water-cementitious ratio by weight
2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi (6.88 MPa) of the specified strength may be used.
3. If less than 15 prior tests are available, the overdesign should be 1,200 psi (8.26 MPa) for specified strengths from 3,000 to 5,000 psi (20.65 to 34.42 MPa) and 1,400 psi (9.64 MPa) for specified strengths greater than 5,000 psi (34.42 MPa).

High range water reducing admixtures shall be capable of maintaining the original slump until placement and screeding, which may be 2 hours, without the addition of water, additional admixture or other retempering or remixing techniques.

C. Workability of Concrete

Concrete shall be uniformly plastic, cohesive and workable. Workable concrete is defined as concrete which can be placed without honeycomb and without voids in the surface of the pavement after the specified finishing machine has been over a given area twice. Workability shall be obtained without producing a condition such that free water appears on the surface of the slab when being finished as specified. Where water appears on the surface of the concrete after finishing and this condition cannot be corrected by reasonable adjustment in the batch design, the bleeding to be immediately corrected by one of the following measures or a combination of two or more of the following listed measures:

1. Redesign of the batch;
2. Addition of mineral filler to fine aggregates;
3. Increase of cement content; or
4. Use of an approved air entraining agent or approved admixture.

In the event that the measures taken do not eliminate the bleeding immediately, concrete placement operations will be suspended, as directed by the Engineer or designated representative, by placing a bulkhead or "header" as indicated and according to applicable requirements for intentional stoppage of placement of concrete under Item No. 360S, "Concrete Pavement" and will remain suspended until such time as additional trial mixes demonstrate that a non-bleeding batch design has been achieved. Failing to achieve a satisfactory laboratory batch design the Contractor will be required to use different materials and to submit samples thereof for additional trial mixes and pilot cylinders.

The mix will be designed with the intention of producing concrete, which will have a slump of 1½ inches (3.8 cms). The slump shall not be less than ½ inch (1.25 cms) nor more than 2 inches (5 cms).

D. Mix Design

The Contractor shall perform at the Contractor's own expense and be responsible for the design of the concrete mix. The mix design shall be prepared and sealed by a person qualified and experienced in such work. Establish proportions on the basis either of laboratory trial batches or of field experience with the materials to be employed.

When ice is used to lower the concrete temperature during hot weather, concrete placement (Section 13 of Standard Specification Item No. 410S, "Concrete Structures"), the Contractor shall furnish a mix design (Section 6 of Standard Specification Item No. 403S, "Concrete for Structures") acceptable to the Engineer or designated representative for class of concrete specified. The addition of ice shall not exceed 50 percent of the total mix water weight.

Complete concrete mix design data shall be submitted to the Engineer or designated representative for approval at least 10 days before concrete placement begins. Submittal of the mix shall be accompanied by such test data and certifications as may be necessary to demonstrate compliance with specification requirements. Approval of this mix design shall in no way relieve the Contractor of responsibility for the quality of the concrete.

It shall also be the responsibility of the Contractor to determine and measure batch quantity of each ingredient, including water, not only for batch designs but for all concrete produced for the project, so that the mix conforms to these specifications.

Trial batches shall be made and tested using all the proposed ingredients prior to the placing of concrete and also when the aggregate and/or type, brand or source of cement or admixture is changed. When the brand and/or source of cement only is changed, the Engineer or designated representative may waive trial batches only if a prior record of satisfactory performance of the cement has been established.

Mix designs used successfully on previous or concurrent jobs may be approved by the Engineer or designated representative without trial batches if it is shown that there is no substantial change in any of the proposed ingredients.

The Contractor shall prepare a minimum of four concrete test cylinders of each mix design, cure and test two each at the age of 7 and 28 days. From these preliminary tests the water-cement ratio required to produce concrete of the specified strength will be selected by the Contractor for approval by the Engineer or designated representative. The Contractor may at any time present in writing a suggested mix design and if the Engineer or designated representative concurs with the suggested design, the Contractor shall conduct trial batches necessary to determine its acceptability under these specification requirements.

The Contractor shall furnish and operate the mixer approved for use on this project unless the concrete is to be furnished from a transit mix (ready-mix) plant. For mixing the concrete to be used in making the preliminary test specimens, a minimum 1 cubic yard (1 cubic meter) batch shall be mixed or a batch of sufficient size to afford proper mixing, whichever is the greater. In lieu of the above mixer and procedure, the Contractor may furnish a portable mixer of sufficient rated capacity to mix a minimum 3-sack batch; in which case, the batch mixed for the preliminary test not to be less than the rated capacity of the mixer furnished. A coating batch will be mixed prior to mixing for test cylinders.

No additional compensation to be allowed for equipment, materials or labor involved in making job mix design test specimens.

After the mix proportions and water-cement ratio required to produce concrete of the specified strength have been determined, placing of the concrete may be started. The strength of the concrete in the completed pavement will be determined by a minimum of four compressive strength test specimens made, cured with a minimum of two each tested at 7 and 28 days as provided in TxDOT Bulletin C-11. Modifications of the mix design may be requested by the Contractor on basis of conformity of the strength of these test specimens with the requirements and intent of this specification.

Changes in the water-cement ratio and the mix design, including an increase in cement factor if necessary, will be made when the average 7 day and/or 28 day compressive strength of the concrete, as indicated by the last 10 compressive strength values obtained from tests of cylinders made from concrete of the same water-cement ratio, departs from the desired minimum average strength by more than 4 percent.

E. Construction Testing

Straightedge surface testing to be carried out as prescribed above.

The Engineer shall take test cylinders for compressive strength values on a random basis. The comparative results shall consist of the average of 2 cylinders each at 7 and 28 days for regular concrete, high early strength concrete and high range water reducing admixture concrete. Tests shall be made for each 500 square yards constructed, in accordance with TxDOT Bulletin C-11. Additional tests may be taken as determined by the concrete placement conditions or for adequately determining the strength of concrete where the early opening of the pavement to traffic is dependent upon concrete strength tests. No extra compensation will be allowed for materials and work involved in fulfilling these requirements.

360S.6 Construction Methods

A. Preparation of Subgrade

Where stabilized subbase is not provided, the subgrade shall be excavated as required, all unstable or otherwise objectionable material removed and all holes, ruts and depressions filled with approved material and compacted. Rolling and sprinkling shall be performed when and to the extent required and the roadbed shall be completed to or above the plane of the typical sections, lines and grades indicated or as established by the Engineer or designated representative. The subgrade shall be proof rolled and any soft areas shall be repaired before the forms are placed. In the event that the proof rolled subgrade is exposed to rainfall or other conditions, which may soften the subgrade, corrective measures shall be taken and the subgrade shall be proof rolled again.

The subgrade planer shall be operated from approved forms immediately ahead of paving operations and the subgrade shall be finished to the exact section of the bottom of the pavement as indicated. Where traveling form pavers are used, the subgrade planer shall operate on a prepared track grade or be controlled by electronic sensors operating from a stringline that establishes line and grade. It shall be tested with the approved template, operated and maintained by the Contractor. The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the pavement is placed and shall be kept thoroughly wetted down sufficiently in advance of placing any pavement to insure its being in a firm and moist condition for at least 2 inches (5 cms) below the prepared surface. Sufficient subgrade shall always be prepared in advance to insure satisfactory prosecution of the work.

No equipment or hauling shall be permitted on the prepared subgrade, except by special permission of the Engineer or designated representative, which will be granted only in exceptional cases and only where suitable protection in the form of 2-ply timber mats or other approved material is provided.

B. Placing and Removing Forms

The subgrade under the forms shall be firm and cut true to grade so that each form section when placed will be firmly in contact for its whole length and base width and exactly at the established grade. Any subgrade under the forms below established grade shall be corrected, using suitable material, placed, sprinkled and rolled as directed. Forms shall be staked with at least 3 pins for each 10-foot (3-meter) section. A pin shall be placed at each side of every joint. Form sections shall be tightly joined and keyed to prevent relative displacement. Forms shall be cleaned and oiled each time they are used.

Forms shall be set for a sufficient distance in advance of the point where concrete is being placed to permit a finished and approved subgrade length of not less than 300 feet (90 meters) ahead of the mixer. Conformity of the grade and alignment of forms shall be checked immediately prior to placing concrete and necessary corrections made by the Contractor. Where any form has been disturbed or any subgrade becomes unstable, the form shall be reset and rechecked. In exceptional cases, the Engineer or designated representative may require suitable stakes driven to the grade of the bottom of the forms to afford additional support. Sufficient stability of forms to support the equipment operated and to withstand its vibration without springing or settlement shall be required. If forms settle and/or deflect over 1/8 inch (3 mm) under finishing operations, paving operations shall be stopped and the forms shall be reset to line and grade.

Forms shall be leveled using cement-stabilized material containing not less than 1½ sacks of cement per ton (1 ⅔ sacks of cement per MG) of mix as placed. The aggregate gradation and water content shall be determined by the Contractor. The cement-stabilized material shall be sufficiently plastic to insure filling voids underneath the paving forms. Paving equipment will not to be permitted on the forms until the cement-stabilized material has cured for at least 12 hours.

Forms shall remain in place for not less than 8 hours after the concrete has been placed. Forms shall be carefully removed in such a manner that little or no damage will be done to the edge of the pavement. Any damage resulting from this operation shall be immediately repaired. After the forms have been removed, the ends of all joints shall be cleaned and any honeycombed areas pointed up with approved mortar and the surfaces protected with curing material conforming to Item No. 409S, "Membrane Curing."

Immediately after pointing is complete, the form trench, if used, shall be filled with granular material or earth from the shoulders in such manner as to shed water from rainfall and prevent curing material from washing away from the edge of pavement. On completion of the required curing, the subgrade or shoulders adjacent to the pavement shall be placed and compacted in condition to maintain drainage.

360S.7 Concrete Mixing and Placing

A. Mixing Methods

The concrete shall be mixed in a mixer conforming to the requirements of this item.

B. Mixing

The aggregates, mineral filler if required, cementitious materials and water shall be measured separately, introduced into the mixer and mixed for a period of not less than 50 seconds nor more than 90 seconds, measured from the time the last aggregate enters the drum to the time discharge of the concrete begins. The required water shall be introduced into the mixing drum during the first 15 seconds of mixing. The entire contents of the drum shall be discharged before any materials of the succeeding batch are introduced.

The Engineer or designated representative may increase the minimum mixing time to that necessary to produce thoroughly mixed concrete based on inspection or appropriate uniformity tests. The mixing time may be varied at any time as necessary to produce acceptable concrete.

If a central mixer is used, the concrete shall be discharged into the specified hauling equipment and delivered to the road site. If truck agitators are used, the concrete shall be continuously agitated at not less than 1 nor more than 6 rpm as directed by the Engineer or designated representative.

The maximum size of the concrete batch, absolute volume, shall not exceed 120 percent of the rated size of the mixer (40.8 cubic feet maximum batch for 34 cubic foot paver - 1.2 cubic meter maximum batch for 1 cubic meter paver). Spilling of material from the mixer drum shall be corrected by reducing the size of the batch. Retempering or remixing of concrete will not be permitted.

The initial batch of concrete mixed after each time the mixer is washed out shall be enriched by additional mortar. The additional mortar shall be 1 sack of cement and 3 parts of sand.

When transit-mix (ready-mix) concrete is permitted, the batching plant shall meet the requirements of Item No. 403S, "Concrete for Structures."

C. Placement

Unless otherwise indicated, the concrete may be placed by using forms or by use of a slipform paver. Any concrete not placed as herein prescribed within 30 minutes after mixing shall be rejected and disposed of as directed except as provided otherwise herein. If in the opinion of the Engineer or designated representative, the temperature, wind and/or humidity conditions are such that the quality of concrete will not be adversely affected, the specified placing time may be extended by a maximum of 45 minutes. Concrete with high range water reducing admixture shall not be placed after the slump has dropped by 3 inches (7.5 cms) or more. Except by specific written authorization of the Engineer or designated representative, concrete shall not be placed when the temperature is below 40°F (4.5°C) and falling but may be placed when the temperature is above 35°F (1.7°C) and rising, the temperature being taken in the shade and away from artificial heat.

When the temperature of the air is above 85°F (29.4°C), an approved retarding agent will be required in concrete. The maximum temperature of all regular concrete placed shall not exceed 95°F (35.0°C), unless otherwise specified.

When concrete is being placed in cold weather, the Contractor shall have available a sufficient supply of an approved covering material to immediately protect concrete if the air temperature falls to 32°F (0°C) or below, before concrete has been placed 4 hours. Such protection shall remain in place during the period the temperature continues below 32°F (0°C) or for a period of not more than 5 days. Neither salt nor other chemical admixtures shall be added to the concrete to prevent freezing. The Contractor shall be responsible for the quality and strength of concrete under cold weather conditions and any concrete damaged by freezing shall be removed and replaced at the Contractor's expense. Concrete shall not be placed before sunrise and shall not be placed later than will permit finishing of the pavement during sufficient natural light.

Concrete shall be placed only on approved subgrade or subbase and unless otherwise indicated on the drawings, the full width of the pavement shall be constructed monolithically. The concrete shall be deposited on the subgrade or subbase in such manner as to require as little rehandling as possible. Where hand spreading is necessary, concrete shall be distributed to the required depth by use of shovels. The use of rakes will not be permitted. Workers will not be permitted to walk in the concrete with any earth or foreign material on their boots or shoes. The placing of concrete shall be rapid and continuous.

When the concrete is to be placed in separate lanes, the junction line shall not deviate from the true line more than ½ inch (1.25 cm) at any point and shall be finished as indicated on the drawings.

The mixer shall not be located on completed pavement, except as herein provided, but may be located on the subgrade of that lane of the pavement being constructed, as provided under "Preparation of Subgrade." When limited space, in the opinion of the Engineer or designated representative, requires operation of the mixer on completed pavement, the mixer may be so operated provided the concrete has attained the minimum average compressive strength required and provided suitable protection to the pavement in the form of 2 ply timber mats or otherwise approved material is provided.

Concrete shall be distributed to such depth that when consolidated and finished, the slab thickness indicated will be obtained at all points and the surface shall not, at any point, be below established grade. Special care shall be exercised in placing and spading concrete against forms and at all joints to prevent the forming of honeycombs and voids.

Concrete for the monolithic curbs shall be the same as for the pavement and if carried back from the paving mixer shall be placed within 20 minutes after being mixed. It may be placed from the separate mixer, if desired, but in any case must be placed while the pavement concrete is still plastic. When sawed joints are

used, curbs shall be doweled as indicated and poured after sawing. Curbs doweled on and placed separately may be placed with an extrusion machine.

If a central mixer or batcher is used, the Contractor shall provide a system satisfactory to the Engineer or designated representative for determining that concrete delivered to the road meets the specified requirements for mixing and time of placing.

Unless otherwise indicated, 2 mixers or transit mixers will be required where the double strike off method is employed.

D. Reinforcing Steel and Joint Assemblies

All reinforcing steel, including steel, welded wire fabric reinforcement, tie bars, dowel bars and load transmission devices used in accordance with plan provisions shall be accurately placed and secured in position in accordance with details indicated on the drawings. Reinforcing bars shall be securely wired together at alternate intersections, following a pattern approved by the Engineer or designated representative and at all splices and shall be securely wired to each dowel intersected. When wire fabric is used, it shall replace only the longitudinal and transverse bars and shall be securely wired together at all splices and to each dowel intersected. When welded wire fabric is selected, the Contractor shall pour the lower half of the slab, place the welded wire fabric and place the remaining concrete. Tie bars shall be installed in the required position by the method and device indicated. Bar coating indicated and of material specified, shall be completed and the bars and coating shall be free of dirt or other foreign matter at the time of installation in the concrete.

Tightly adhered scale or rust which resists removal by vigorous wire brushing need not be removed except that excessive loss of section to the reinforcement due to rust shall be cause for rejection. Excessive loss of section shall be defined as loss of section to the extent that the reinforcement will no longer meet the physical requirements for the size and grade of steel specified.

Where indicated on the drawings, an assembly of parts at pavement joints, the assembly shall be completed, placed at required location and elevated and all parts rigidly secured in required position by the method and devices indicated on the drawings. Dowel bars shall be accurately installed in joint assemblies as indicated on the drawings, each parallel to the pavement surface and to the center line of the pavement and shall be rigidly secured in the required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Unless specifically authorized by the Engineer or designated representative in writing, the load transmission devices shall be accurately installed in joint assemblies indicated, each unit vertical with its length parallel to the center line of the pavement and all units shall be rigidly secured in required position by such means as indicated that will prevent their displacement during placing and finishing of the concrete. Header boards, joint filler and other material used for forming joints shall be accurately notched to receive each load transmission device. All load transmission devices shall be free of rust and clean when installed in the concrete.

The Contractor has the option of substituting welded wire fabric in place of reinforcement bars. The welded wire fabric selected shall have an area and distribution of steel at least equal to the plan requirements. The Contractor shall submit their proposed design to the Engineer for approval before any material is ordered.

If welded wire fabric is used, the entire width of the bottom layer of concrete shall be struck off to conform to the cross section and elevation indicated on the drawings. The reinforcement shall then be placed immediately upon the concrete, after which the top layer of concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 15 minutes without being covered with the top layer of concrete shall be removed and replaced with freshly mixed concrete at the Contractor's expense.

E. Joints

1. General

All transverse and longitudinal joints when required in the pavement shall be of the types indicated and shall be at required location, on required alignment, in required relationship to tie bars and joint assemblies and in accordance with details indicated. When no transverse joints are indicated, joints shall not exceed 40 feet (13.1 meters). Such stakes, braces, brackets or other devices shall be used as necessary to keep the entire joint assembly in true vertical and horizontal position. Where concrete base is overlaid by asphaltic concrete, the joints to be prepared as specified herein, but joint sealing will not be required unless indicated.

If necessary for proper installation of the sealer, excessive spalling of the joint groove shall be repaired to the satisfaction of the Engineer.

Care shall be exercised during the construction of all joints to insure that the concrete sections are completely separated by an open joint or by the joint materials and to insure that the joints will be true to the outline indicated on the drawings. The Contractor shall install joint materials, which will function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.

Green concrete or wet sawed joints are permitted provided the Contractor cleans the joint within 5 minutes after cutting with a 3,000 psi (20.7 mPa) water blast followed by a minimum of 7 day cure and sand blast the saw cut immediately prior to placing joint sealer.

Dry sawed joints are permitted provided the Contractor sand blasts the saw cut immediately prior to placing joint sealer.

2. Expansion Joints

Transverse expansion joints shall be formed perpendicular to the centerline and surface of pavement and shall be constructed in accordance with the sequence of operations indicated on the drawings. After the transverse finishing machine and before the longitudinal finishing machine have passed over the joint, the Contractor shall test the joint filler for correctness of position and make any required adjustment in the position of the filler and shall install the joint seal space form as indicated on the drawings. After removal of the joint seal form as indicated on the drawings, the joint seal space above the joint filler shall be thoroughly sandblasted or machine routed to remove all projecting concrete, laitance, dirt or foreign matter. The concrete faces of the joint seal space shall be left true to line and section throughout the entire length of the joint. On completion of curing of the pavement, the joint sealing filler of the type specified shall be placed as indicated. The faces of the joint seal space shall be clean and surface dry at the time joint sealing filler is placed. On completion of the joint seal, the pavement adjacent to the joint shall be left free of joint sealing material. The joint seal space shall be exactly above and not narrower than the joint filler with no concrete overhangings.

3. Weakened Plane Joints

Weakened plane joints shall consist of transverse contraction joints and longitudinal joints and shall be formed or sawed as indicated on the drawings. When the joints are sawed, the saw shall be power driven, shall be manufactured especially for the purpose of sawing concrete and shall be capable of performing the work. Saw blades shall be as indicated. Tracks adequately anchored, the chalk, string line or other approved methods shall be used to provide true alignment of the joints. The concrete saw shall be maintained in good operating condition and the Contractor shall keep a standby power saw on the project at all times when concrete operations are under way.

If membrane curing is used, the portion of the seal, which has been disturbed by sawing operations, shall be restored by the Contractor by spraying the areas with additional curing seal.

Forming, finishing and sealing of the joint seal space shall conform to this item, described above and details indicated on the drawings.

4. Contraction Joints

Transverse contraction joints shall be formed or sawed joints perpendicular to the centerline and surface of the pavement and shall be constructed by the method and in the sequence of operations as indicated. Where sawed joints are used, contraction joints at intervals indicated shall be sawed as soon as sawing can be accomplished without damage to the pavement and before 24 hours after the concrete has been placed, the exact time to be approved by the Engineer or designated representative. The remaining contraction joints shall be sawed in a uniform pattern as directed by the Engineer or designated representative and they shall be completed before uncontrolled cracking of the pavement takes place. All joints shall be completed before placing concrete in succeeding lanes and before permitting traffic to use the pavement.

5. Longitudinal Joints

Longitudinal joints shall be of the type or alternate types indicated and shall be constructed of specified materials in accordance with provisions indicated on the drawings. Longitudinal joints shall be constructed accurately to required lines, shall be perpendicular to the pavement surface at the joint and the pavement surface over and adjacent to the joint shall be finished as specified on the drawings.

Longitudinal joints shall be sawed as soon as sawing can be accomplished without damage to the pavement. Sawing shall not cause damage to the pavement and the groove shall be cut with a minimum of spalling. No traffic (including construction traffic) shall be permitted on pavement until the longitudinal joint is cut.

6. Construction Joints

Intentional stoppage of the placing of the concrete shall be at either an expansion joint or at a weakened plane joint. The following provisions shall govern for each type of joint at which the placing of concrete is stopped:

- a) When the placing of concrete is stopped at an expansion joint, the complete joint assembly shall be installed and rigidly secured in required position as indicated. A bulkhead of sufficient cross sectional area to prevent deflection, accurately notched to receive the load transmission devices or dowels, as the case may be, and shaped accurately to the cross section of the pavement shall be provided and installed as a back-up for the joint filler and rigidly secured in required position to permit accurate finishing of the concrete up to the joint. After the concrete has been finished to the joint, formation of the joint seal space and finishing of the joint shall be executed as specified herein and as indicated. The backup bulkhead shall remain in place until immediately prior to the time when concrete placement is resumed, then it shall be carefully removed in such manner that no element of the joint assembly will be disturbed. The exposed portion of the joint assembly shall be free of adherent concrete, dirt or other material at the time placing of concrete is resumed.
- b) When placing of concrete is stopped at a weakened plane joint, all applicable provisions of paragraph (a) above shall apply in addition to the following requirement:

The face of the bulkhead adjoining the slab end shall be notched and grooved to fit the exposed half section of the joint assembly and shall be shaped to form the slab end at the center of the joint as indicated on the drawings. The ½ width of joint seal space may be formed by a strip of required section placed and removed as indicated for construction of transverse contraction joints. The Contractor shall have available a bulkhead shaped to section of the pavement. This bulkhead must be drilled to permit the continuation of all longitudinal reinforcing steel through the construction joint and shall be of sufficient section and strength to prevent deflection.
- c) When load transmission devices are not provided in the design, intentional stopping of placement of concrete shall occur in the middle of a slab. Provisions shall be made to provide a bulkhead, which will accommodate tie bars of the same length, size and spacing as tie bars used

for the longitudinal joints. When the concrete placement is resumed, the bulkhead shall be removed without bending tie bars or damaging the concrete. The joint seal space and sealer shall be the same as for longitudinal joints.

Immediately upon the unintended stoppage of the placing of concrete, the Contractor shall place the available concrete to a line and install the above-described bulkhead at right angles to the centerline of the pavement, perpendicular to the surface and at the required elevation. Concrete shall be placed and finished to this bulkhead. Any concrete remaining on the subgrade ahead shall be removed and disposed of as directed by the Engineer or designated representative. When placing of concrete is resumed before the concrete has set to the extent that the concrete will stand on removal of the bulkhead, the new concrete shall be rodded with the first. An edge created by a construction joint of this type shall have a joint seal space and shall be sealed as required for contraction joints.

F. Joint Sealers

1. Class 2 Material

This material shall conform to Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)".

For placement in vertical joints (curb faces, etc.) either of the following procedures may be used.

- a) An amount of the mixed material may be set aside until partial curing has taken place and carefully trowelled into the joint with a suitable tool.
- b) The portion of the joint in the roadway shall be poured and cured. The vertical curb faces shall then be taped or formed and the material poured into the vertical joint from the top.

2. Class 5 Material

This material together with backer rods shall be applied as indicated in accordance with manufacturer's recommendations.

G. Asphalt Board

Premolded materials, wherever used, shall be anchored to the concrete on one side of the joint by means of copper wire or nails not lighter than No. 12 B and S gage. Such anchorage shall be sufficient to overcome the tendency of the material to fall out of the joint. The Contractor shall not contaminate joints to receive Class 5 Joint Material with asphalt from the asphalt board.

H. Curbs

The curb shall be constructed in lengths equal to the adjoining pavement slab lengths and expansion joints shall be provided in the curb opposite each transverse expansion joint in the pavement. Expansion joint material shall be of the same thickness, type and quality as indicated for the pavement and shall be of the section as indicated for the curb. All expansion joints shall be carried through the curb, sidewalk and retaining walls when these items are indicated.

When sawed joints are provided for the pavement, the curb placement shall be delayed until all transverse joints have been sawed. To provide bond for the curb, dowel bars shall be placed as indicated on the drawings, while the pavement concrete is still plastic.

Weakened plane joints shall be formed in monolithic curbs at a spacing to coincide with the joints in the concrete pavement. The joints shall be formed by inserting in the curb an asphaltic board strip cut to conform to the shape of the curb. When the concrete is sufficiently set, the joint on the top and face of curb shall be grooved with an approved type of grooving tool.

A finish coat of mortar shall be applied on the exposed surfaces of the monolithic curbs. The mortar shall be composed of 1 part of Portland Cement and 2 parts of fine aggregate. A mortar coat will not be required for extruded curbs.

The curb face, lower radius and top of curb shall be plastered with the sand-cement mortar. The mortar shall be applied with a template or "mule" made to conform to the curb dimensions as indicated. All exposed surfaces of the curb shall be finished with a steel trowel and brushed to a smooth and uniform surface. The mortar finish as required shall be included in the unit price bid for this item.

I. Machine Finishing

All concrete pavement shall be finished mechanically with approved self-propelled machines, except as herein provided. Hand finishing will be permitted on the transition from a crowned section to a superelevated section without crown on curves, on straight line superelevation sections less than 300 feet (91.4 meters) in length, on that portion of a widened pavement outside normal pavement width and on sections where the pavement width is not uniform, isolated, narrow in width or required monolithic widths are greater than that of available finishing machines.

Machine finishing of pavement shall include the use of power-driven vibrators, power-driven transverse strike off and screed or such alternate equipment as may be substituted and approved under this item.

All concrete pavement shall be consolidated by a mechanical vibrator. As soon as concrete has been spread between the forms, the approved mechanical vibrator shall be operated to consolidate the concrete and remove all voids. Hand manipulated vibrators shall be used for areas not covered by the mechanical vibratory unit.

The transverse finishing machine shall first be operated to compact and finish pavement to the required section and grade, without surface voids. The machine shall be operated over each area as many times and at such intervals as directed. At least 2 trips will be required and the last trip over a given area shall be a continuous run of not less than 40 feet (12.2 meters). After completion of finishing with the transverse finishing machine, a transverse drag float may be used.

The consistency of the concrete as placed should allow completion of finishing operations without the addition of water to the surface. When field conditions are such that additional moisture is needed for the final concrete surface finishing operation, the required water shall be applied to surface by fog spray only and shall be held to a minimum.

After finishing is complete and the concrete still workable, the surface shall be tested by the Contractor for trueness with an approved 10 foot (3.05 meter) straightedge. The straightedge shall be operated from the side of the pavement, placed parallel to the pavement centerline and passed across the slab to reveal any high spots or depressions. The straightedge shall be advanced along the pavement in successive stages of not more than ½ its length. Practically perfect contact of the straightedge with the surface will be required and the pavement shall be leveled to this condition, in order to insure conformity with the surface test required below after the pavement has fully hardened. Any correction of the surface required shall be accomplished by adding concrete if required and by operating the longitudinal float over the area. The surface test with the straightedge shall then be repeated.

For one lane pavement placement and uniform widening, the equipment for machine finishing of concrete pavement shall be as directed by the Engineer or designated representative but shall not exceed requirements of these specifications.

After completion of the straightedge operation, as soon as construction operations permit, texture shall be applied with ⅛ inch (3 mm) wide metal tines with clear spacing between the tines being not less than ¼ inch (6.3 mm) nor more than ½ inch (12.7 mm).

If approved by the Engineer or designated representative, other equipment and methods may be used, provided that a surface texture meeting the specified requirements is obtained. The texture shall be applied transversely. It is the intent that the average depth resulting from the number of tests directed by the Engineer or designated representative be not less than 0.060 inch (1.52 mm) with a minimum texture depth of 0.050 inch (1.27 mm) for any one test when tested in accordance with TxDOT Test Method Tex-436-A. Should the texture depth fall below that intended, the finishing procedures shall be revised to produce the desired texture.

1. Emergency Procedures

The Contractor shall have available at all times hand rakes with tines for the purpose of providing textures in the event of equipment breakdown.

The Contractor also shall have available a conventional garden spray type can containing a commercially available monomolecular film compound. This shall be applied in the case of equipment breakdown or other emergencies to prevent the pavement from drying too rapidly. The use of this product will give the Contractor additional time to provide adequate texturing.

After completion of texturing and about the time the concrete becomes hard, the edge of the slab and joints shall be carefully finished with an edger and the pavement shall be left smooth and true to line.

J. Hand Finishing

Hand finishing shall be resorted to only in those conditions provided for above and upon specific authorization by the Engineer or designated representative. When hand finishing is permitted, concrete shall be struck off with an approved strike off screed to such elevation that when consolidated and finished the surface of the pavement to conform to the required section and grade. The strike template shall be moved forward with a combined transverse and longitudinal motion in the direction work is progressing, maintaining the template in contact with the forms and maintaining a slight excess of material in front of the cutting edge. The Concrete shall then be tamped with an approved tamping template to compact the concrete thoroughly and eliminate surface voids and the surface screed to required section.

After completion of a strike off, consolidation and transverse screeding, a hand-operated longitudinal float shall be operated to test and level the surface to the required grade.

Workers shall operate the float from approved bridges riding on the forms and spanning the pavement. The longitudinal float shall be held in contact with the surface and parallel to the centerline and operated with short longitudinal strokes while being passed from one side of the pavement to the other. If contact with the pavement is not made at all points, additional concrete shall be placed, if required and screed and the float shall be used to produce a satisfactory surface. Care shall be exercised to keep the ends of the float from digging into the surface of the pavement. After a section has been smoothed so that the float maintains contact with the surface at all points in being passed from one side to the other, the bridges may be moved forward half the length of the float and the operations repeated.

Other operations and surface tests shall be as required for machine finishing.

K. Surface Testing

After the concrete has been placed 12 hours or more, the Engineer or designated representative will test the surface of the pavement with a 10-foot (3.05 meter) straightedge placed parallel to the centerline. Unless specified otherwise, the surface shall not vary from the straightedge by more than 1/16 inch per foot (5 mm per meter) from the nearest point of contact and in no case shall the maximum ordinate from a straightedge to the pavement be greater than 1/8 inch (3 mm). Any high spots causing a departure from the straightedge in excess of that specified shall be ground down by the Contractor to meet the surface test requirements. Where the texture of the pavement is removed by extensive grinding, the texture shall be restored by grooving the concrete to meet the surface finishing specifications.

L. Curing

All concrete pavement shall be cured by protecting it against loss of moisture for a period of not less than 72 hours from the beginning of the curing operations. Immediately after finishing operations have been completed, the entire surface of the newly laid concrete shall be covered and cured in accordance with the requirements specified for whichever of the following methods the Contractor may elect. Newly laid concrete base to be overlaid by asphaltic concrete shall not be cured by "Membrane Curing" and surfaces not to be overlaid by asphaltic concrete shall not be cured by "Asphalt Curing." In all cases in which curing requires the use of water, the curing shall have prior right to water supply or supplies. Failure to provide sufficient cover material of the type the Contractor elects to use, failure to maintain saturation in wet curing methods, lack of water to adequately take care of both curing and other requirements or other failures to comply with curing requirements shall be cause for immediate suspension of concreting operations. The covering material used in curing shall be removed as necessary to saw joints or to comply with the requirements for "Surface Test." The concrete surface shall be maintained wet with a water spray if indicated and the covering material replaced immediately on completion of sawing and testing and any required surface correction.

1. Waterproofed Paper Curing

Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with waterproofed paper so placed and weighted as to cause it to remain in intimate contact with the surface. Waterproofed paper used for the curing of concrete pavement shall be of a type and quality approved by the Engineer. It shall be sufficiently strong and tough to permit its use under the conditions existing on street paving work without being torn or otherwise rendered unfit for the purpose during the curing period. The paper covering shall be maintained in place continuously for not less than the specified curing period.

The waterproofed paper shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab and such blankets shall not be more than 60 feet in length. All joints in the blankets occasioned by joining paper sheets shall lap not less than 5 inches (12.7 cms) and shall be securely sealed with asphalt cement having a melting point of approximately 180°F (82.2°C). Blankets shall be placed to secure an overlap of at least 12 inches (30.5 cms) and this lap securely weighted to form a closed joint.

The waterproofed paper blankets shall be adequately weighted to prevent displacement or billowing due to wind and the paper folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place will not be permitted.

All tears or holes appearing in the paper during the curing period shall be immediately repaired by cementing patches over such defects. It shall be the Contractor's responsibility to prevent damage to paper blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer or designated representative at any time if it appears they do not provide an airtight covering.

Paper blankets rejected on account of pinholes or minor tears may be continued in service by folding the blanket over lengthwise, first thoroughly spraying ½ the blanket with the asphalt cement used for seams. The 2 thicknesses shall be firmly pressed together and well cemented. Blankets shall be of a width sufficient to cover the pavement surface and both edges. Doubled blankets may be rejected for the same cause as provided for single blankets. All paper blankets rejected by the Engineer shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

No walking on paper shall be permitted at any time and, in locations where pedestrian traffic cannot be entirely controlled, the Contractor shall provide walkways and barricades or shall substitute other permissible curing methods on such sections of pavement.

2. Polyethylene Film Curing

Immediately after the finishing of the surface has been completed and the concrete has taken its initial set, it shall be wetted with water applied in the form of a fine spray and covered with the polyethylene film so placed and weighted as to cause it to remain in intimate contact with the surface. The polyethylene film covering shall be maintained in place continuously for not less than the specified curing period.

The film shall be prepared to form blankets of sufficient width to cover the entire surface and both edges of the pavement slab. All joints in the blankets occasioned by joining film sheets shall lap not less than 12 inches (30.5 cms). All joints shall be sealed in a manner acceptable to the Engineer or designated representative to provide a moisture-proof lap.

The polyethylene film blankets shall be adequately weighted to prevent displacement or billowing due to wind and the film folded down over the side of the pavement shall be secured by a continuous bank of earth. Plowing of this windrow into place not to be permitted.

All tears or holes appearing in the polyethylene film during the curing period shall be immediately repaired by placing acceptable moisture proof patches over such defects or by replacing the blankets. It shall be the Contractor's responsibility to prevent damage to the film blankets, which would affect their serviceability and effectiveness as a concrete curing method. Blankets may be rejected by the Engineer at any time if it appears they do not provide an airtight covering.

Polyethylene film blankets rejected on account of pinholes or minor tears may be continued in service when repaired to an airtight condition. All polyethylene film blankets rejected by the Engineer or designated representative shall be immediately marked by the Contractor for identification and then destroyed or stored entirely separate from approved blankets.

Should the film blanket be damaged or torn for any cause during the first 72 hours of the curing period such damage shall be repaired immediately.

3. Membrane Curing

Immediately after the finishing of pavement has been completed and after the free surface moisture has disappeared, the pavement shall be sprayed uniformly with a curing compound. Membrane curing shall conform to Standard Specification Item No. 409S, "Membrane Curing," Type 2 white pigmented. Should the film of compound be damaged from any cause before the expiration of 72 hours after original application, the damaged portions shall be repaired with additional compound. Unless otherwise indicated on the drawings, membrane curing shall be used when the concrete (except that concrete to be used as a base) is placed with a slip form paver.

4. Asphalt Curing

Where emulsified asphalt is used for curing concrete base, the material shall conform to Item No. 301S, "Asphalts, Oils and Emulsions," for the type and grade shown on the drawings. The rate of application may vary between the limits of 1 gallon per 180 square feet and 1 gallon per 90 square feet (1 liter per 4.4 square meters and 1 liter per 2.2 square meters). The rate of application will be determined by the Engineer or designated representative, after observation of sections where amounts varying between the above limits have been applied. If it is found necessary to add water to the emulsion for the proper distribution through the spray, this may be done upon approval of the Engineer or designated representative. When the emulsion is diluted with water the amount of the applied mixture shall be

increased to give a coverage of the original emulsion between the limits as set out herein. Care shall be taken to properly mix the emulsion and water and to keep the mixture well agitated during application.

M. Protection of Pavement

The Contractor shall erect and maintain the barricades indicated on the drawings and such other standard and approved devices as will exclude public traffic and traffic of the Contractor's employees and agents from the newly placed pavement for a minimum of 14 days. Portions of the roadway or crossings of the roadbed required to be maintained open for use by traffic shall not be obstructed by above required barricades. Crossings of the pavement indicated on the drawings or by construction sequence, during the period prior to opening to traffic as herein indicated, shall be provided with an adequate and substantial bridge approved by the Engineer or designated representative.

Curb shall be backfilled to the full height of the concrete, tamped and sloped as indicated on the drawings or as directed by the Engineer. The top 4 inches (10 cms) of backfill shall be of clean, friable soil capable of supporting plant life. This material shall also be free of stones and all other debris.

N. Opening Pavement to Traffic

The pavement shall be closed to traffic, including vehicles of the Contractor, until the concrete is at least 14 days old and has attained an average compressive strength acceptable to the Engineer or designated representative. This period of closure to traffic may be extended if, in the opinion of the Engineer or designated representative, weather or other conditions make it advisable to provide an extension of the time of protection.

At the end of the 14 day period and as long thereafter as ordered by the Engineer or designated representative and if so desired by the Contractor, the pavement may be opened for use by vehicles of the Contractor provided the gross weight (vehicle plus load) of such vehicles does not exceed 14,000 pounds (6,350 KGs). Such opening, however, shall in no manner relieve the Contractor from responsibility for the Contractor's work. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and topsoil placed against the pavement edges or behind the curb where turf or vegetation is to be established before permitting vehicles thereon.

After the concrete in any section is 14 days old or as long thereafter as ordered by the Engineer, such section of pavement may be opened to all traffic indicated on the drawings or when so directed by the Engineer or designated representative. On those sections of the pavement thus opened to traffic, all joints shall first be sealed, the pavement cleaned and 4 inches (10 cms) of top soil placed against the pavement edges and all other work performed as required for the safety of traffic. Such opening, however, shall in no manner relieve the Contractor from responsibility for the Contractor's work performed.

When High Early Strength Concrete, resulting from the use of Type III cement as indicated on the drawings is used, the pavement may be opened to all traffic after the concrete is 7 days old or as long thereafter as ordered by the Engineer or designated representative, subject to the same provisions governing the opening after 14 days as above indicated.

Where the Contractor desires to move any equipment not licensed for operation on public streets, on or across any pavement opened to traffic, the Contractor shall protect the pavement from damage by means of 2 ply timber mats of 2 inch (5 cm) stock or runways of heavier material laid on a layer of earth, all as approved by the Engineer or designated representative.

1. Emergency Opening to Traffic

The Engineer or designated representative may require the opening of pavement to traffic prior to the minimum time specified above under conditions of emergency, which in the Engineer's or designated representative's opinion require such action in the interest of the public. In no case will the Engineer or designated representative order opening of the pavement to traffic within less than 72 hours after the

last concrete in the section is placed. The Contractor shall remove all obstructing materials, place earth against pavement edges and perform other work involved in providing for the safety of traffic as required by the Engineer or designated representative in ordering emergency opening. Orders for emergency opening of the pavement to traffic will be issued by the Engineer or designated representative in writing.

360S.8 Penalty for Deficient Pavement Thickness or Strength

The adjustment in unit prices provided for in this item will apply only when measurement for payment is by the square yard.

It is the intent of this specification that the pavement be constructed in strict conformity with the thickness, strength and typical sections indicated on the drawings. Where any pavement is found not so constructed, the following rules relative to adjustment of payment for acceptable pavement and to replacement of faulty pavement shall govern.

A. Pavement

The pavement will be core drilled after any grinding operations have been completed for surface corrections prior to final acceptance. Locations of core tests may be selected by the Engineer or designated representative; however, spacing interval for core tests, as specified herein, shall be maintained. The thickness of the pavement will be determined by measurement of the cores in accordance with TxDOT Test Method Tex-424-A.

For the purpose of establishing an adjusted unit price for pavement, units to be considered separately are defined as 1,000 linear feet of pavement in each traffic lane starting at the end of the pavement bearing the smaller station number. The last unit in each lane shall be 1,000 feet plus the fractional part of 1,000 feet remaining. Traffic lane width will be as shown on typical sections and pavement design standards.

For the purpose of establishing an adjusted unit price for ramps, widening, acceleration and deceleration lanes that are machine placed, isolated pavements of traffic lane width but less than 1,000 feet in length and other areas designated by the Engineer or designated representative, units will be considered separately and are defined as 1,000 square yards of pavement or fraction thereof.

One core will be taken at the location selected by the Engineer or designated representative or at random in each unit. When the measurement of the core from any unit is not deficient more than 0.2 inches from the plan thickness, full payment will be made. When the measurement of the core from any unit is deficient more than 0.2 inch but not more than 0.75 inch from the plan thickness, 2 additional cores will be taken from the unit and the average of the 3 cores determined. The 2 additional cores from any 1,000-foot unit will be taken at intervals of not less than 300 feet. The 2 additional cores from any 1,000 square yard unit will be taken at locations such that the pavement in the unit will be well represented. If the average measurement of these 3 cores is not deficient more than 0.2 inches from the plan thickness, full payment will be made. If the average thickness of the 3 cores is deficient by more than 0.2 inch but not more than 0.75 inch from the indicated thickness, an adjusted unit price as provided below will be paid for the areas represented by these cores.

In calculating the average thickness of the pavement, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch and measurements which are less than the specified thickness by more than 0.75 inch will be considered as the specified thickness less 0.75 inch.

When the measurement of any core is less than the specified thickness by more than 0.75 inch, the actual thickness of pavement in this area will be determined by taking additional cores at 10 foot intervals parallel to the center line in each direction from the deficient core until, in each direction, a core is taken which is not

deficient by more than 0.75 inch. Exploratory cores for deficient thickness will not be used in averages for adjusted unit price. Exploratory cores are to be used only to determine the length of pavement in a unit that is to be left in place without pay and/or removed and replaced as provided herein.

For new Concrete Pavement roadways, and for Concrete Pavement rehabilitation and overlay projects, if cracks develop in the pavement surface within the one year warranty period, the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)", or perform other corrective measures as directed by the Engineer. Payment for this work will be considered subsidiary to Concrete Pavement, unless included as a separate pay item in the Contract.

For new Concrete Pavement roadways, and for Concrete Pavement rehabilitation and overlay projects, if cracks develop in the pavement surface within the one year warranty period, the Contractor shall seal the cracks in accordance with Standard Specification Item No. 313S, "Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)", or perform other corrective measures as directed by the Engineer. Payment for this work will be included in the unit price bid for Concrete Pavement, unless included as a separate pay item in the Contract.

Irrespective of an acceptable overall project average for any or all of the Pay-Adjustment Acceptance Factors, limited substandard portions of the work, as determined by the Engineer or designated representative, shall be remedied or removed and replaced to the satisfaction thereof.

B. Price Adjustments

After any grinding or milling operations have been completed to meet the surface-testing requirement of this specification, if average thickness of pavement is deficient in thickness by more than 0.2 inch, but not more than 0.75 inch, payment will be made at an adjusted price as specified in the following table:

Concrete Pavement Deficiency	
Deficiency in Thickness Determined by Cores, Inches	Proportional Part of Contract Price Allowed
0.00 to 0.20	100 percent
0.21 to 0.30	80 percent
0.31 to 0.40	72 percent
0.41 to 0.50	68 percent
0.51 to 0.75	57 percent

Any area of pavement found deficient in thickness by more than 0.75 inch but not more than 1 inch or $\frac{1}{8}$ of the indicated thickness, whichever is greater, shall be evaluated by the Engineer. If, in the judgment of the Engineer, the area of such deficiency should not be removed and replaced, there will be no payment for the area retained. If, in the judgment of the Engineer, the area of such deficiency warrants removal, the area shall be removed and replaced at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.

Any area of pavement found deficient in thickness by more than 1 inch or more than $\frac{1}{8}$ of the indicated thickness, whichever is greater, shall be removed and replaced, at the Contractor's entire expense, with concrete of the thickness indicated on the drawings.

No additional payment over the Contract unit price will be made for any pavement of a thickness exceeding that indicated on the drawings.

If the average compressive strength based on concrete test cylinders at 28 days is less than the specified minimum strength of the concrete, then payment will be made at an adjusted price as specified in the following table.

Pay Adjustment Factor for Deficient Compressive Strength	
Ratio of Average Strength from Test Cylinders to Specified Minimum Compressive Strength both at 28 Days	Proportional Part of Contract Price Allowed
More than 0.95	100 percent
0.90 to 0.95	85 percent
0.85 to 0.90	70 percent
0.80 to 0.85	60 percent
Less than 0.80	0 percent (Remove & Replace)

When, in the opinion of the Engineer or designated representative, the compressive strength test results appear unrepresentative, additional testing of field cores may be authorized. To be considered acceptable for consideration the field cores shall be acquired, properly handled and tested in accordance with ASTM C 42/C 42M, "Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete" within 45 days of the original concrete placement date. The retesting will be at the expense of the Contractor and the results of the retesting shall be averaged with the results of the original testing. If the results of retesting indicate that the original test results were erroneous in the opinion of the Engineer or designated representative, the original test results will be discarded. In the instance of erroneous original test results the subsequent first set of retests will be at the expense of the City of Austin.

When, in the opinion of the Engineer or designated representative, the concrete compressive strength is deemed unacceptable for the intended use of the pavement, the concrete shall be removed and replaced to the limits indicated by test results.

360S.9 Measurement

- A. When indicated, concrete pavement will be measured by the square yard of surface area of completed and accepted work. The surface area shall be so measured to also include that portion of pavement slab extending beneath the curb. When concrete pavement is to be measured by the square yard and monolithic curb is required, measurements for "Monolithic Curb" will be by the linear foot complete in place.
- B. When indicated on the drawings, concrete pavement, including monolithic curb when required, will be measured by the cubic yard of absolute volume of materials entering the mixture.

360S.10 Payment

The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit price bid for "Concrete Pavement," of the depth indicated on the drawings, "Concrete Pavement (High Early Strength)" of the depth indicated on the drawings and "Monolithic Curb" of the type indicated on the drawings (when pavement is measured by the square yard), as required or adjusted unit price for pavement of deficient thickness as provided under "Deficient Pavement Thickness", which price shall be full compensation for shaping and fine grading the roadbed, including furnishing and applying all water required; for furnishing, loading and unloading, storing, hauling and handling all concrete ingredients, including all freight and royalty involved; for placing and adjusting forms, including supporting material or preparing track grade; for mixing, placing, finishing, sawing, cleaning and sealing joints and curing all concrete; for furnishing and installing all reinforcing steel; for furnishing all materials for sealing joints and placing longitudinal, expansion and weakened plane joints, including all steel dowel caps and load transmission devices required and wire and devices for placing, holding and supporting steel bars, load transmission devices and joint filler material in proper position, for coating steel bars where complete the work.

Excavation required by this item in the preparation of the subgrade and for completion of the parkway will be measured and paid for in accordance with provisions governing the Items of "Street Excavation" and "Borrow," respectively, with provision that yardage to be measured and paid for once only, regardless of manipulations involved. Measurement of subgrade excavation for payment shall be limited to a total width of that of pavement plus 1 foot on each side.

Sprinkling and rolling required for the compaction of the rough subgrade in advance of fine grading will be measured and paid for as indicated in the governing items of excavation. Maintenance of a moist condition of the subgrade in advance of fine grading and concrete placing will not be paid for directly but shall be included in the unit price bid, as provided above.

Payment will be made under one of the following:

Pay Item No. 360S-A:	In. Concrete Pavement	Per Square Yard.
Pay Item No. 360S-AH:	In. Concrete Pavement (High Early Strength)	Per Square Yard.
Pay Item No. 360S-AS:	In. Concrete Pavement (High Range Water Reducing Admixture)	Per Square Yard.
Pay Item No. 360S-B:	Monolithic Curb	Per Linear Foot.
Pay Item No. 360S-C:	Concrete Pavement Including Monolithic Curb	Per Cubic Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS	
Standard Specification Item 360S, "Concrete Pavement"	
City of Austin Standard Specification Items	
<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 313S	Cleaning and/or Sealing Joints and Cracks (Asphaltic Concrete)
Item No. 403S	Concrete for Structures
Item No. 405S	Concrete Admixtures
Item No. 410S	Concrete Structures
Item No. 411S	Surface Finishes for Concrete
Item No. 413S	Cleaning and/or Sealing Joints and Cracks (PCC)
American Society for Testing and Materials, ASTM	
<u>Designation</u>	<u>Description</u>
ASTM C 42/C 42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete"
ASTM A 82	Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184	Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615	Specification for Deformed and Plain Billet-Steel Bars, for Concrete Reinforcement
ASTM A 616	Specification Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM C 94	Specification for Ready-Mixed Concrete
ASTM C 150	Specification for Portland Cement
ASTM C 156	Test Method for Water Retention by Concrete Curing Materials
ASTM D 2240	Test Method for Rubber Property-Durameter Hardness

ASTM D 882, Method A	Test Methods for Tensile Properties of Thin Plastic Sheeting
<u>Texas Department of Transportation: Publications</u>	
<u>Designation</u>	<u>Description</u>
Bulletin C-11	Construction Bulletin
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
TEX-203-F	Sand Equivalent Test
TEX-401-A	Sieve Analysis of Fine and Coarse Aggregate
TEX-406-A	Mineral Finer than 75 µm (No. 200) Sieve in Mineral Aggregates (Decantation Test for Concrete Aggregates)
TEX-408-A	Organic Impurities in Fine Aggregate for Concrete
TEX-410-A	Abrasion of Coarse Aggregate Using The Los Angeles Machine
TEX-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
TEX-413-A	Determination of Deleterious Materials in Mineral Aggregate
TEX-415-A	Slump of Portland Cement Concrete
TEX-416-A	Air Content of Freshly-Mixed Concrete by the Pressure Method
Tex-418-A	Compressive Strength of Cylindrical Concrete
Tex-424-A	Obtaining and Testing Drilled Cores of Concrete
Tex-436-A	Measurement of Texture Depth by the Sand Patch Method
Tex-524-C	Testing Premolded Joint Filler for Concrete
Tex-612	Acid Insoluble Residue
<u>Texas Department of Transportation: Departmental Material Specifications</u>	
<u>Designation</u>	<u>Description</u>
DMS 8900	Fly Ash
<u>American Association of State Highway & Transportation Officials, AASHTO Standard</u>	
<u>Designation</u>	<u>Description</u>
Method T 26	Quality of Water to be Used in Concrete

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item 360S, "Concrete Pavement"</u>	
Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges	
<u>Designation</u>	<u>Description</u>
Item 360	Concrete Pavement
Item 420	Concrete Structures
Item 421	Hydraulic Cement Concrete
Item 427	Surface Finishes for Concrete
Item 431	Pneumatically Placed Concrete
Item 520	Weighing and Measuring Equipment
<u>Texas Department of Transportation: Departmental Material Specifications</u>	
<u>Designation</u>	<u>Description</u>
DMS-4650	Hydraulic Cement Concrete Curing Materials and Evaporation Retardants"

DMS-6100	Epoxy and Adhesives
<u>American Society for Testing and Materials, ASTM</u>	
<u>Designation</u>	<u>Description</u>
ASTM C 685	Concrete Made By Volumetric Batching and Continuous Mixing
ASTM C-1260	Standard Test Method for Potential Alkali Reactivity of Aggregates
ASTM D-512	Test Methods for Chloride Ion in Water
ASTM D-516	Test Methods for Sulfate Ion in Water
ASTM D-4191	Test Method for Sodium in Water by Atomic Absorption
ASTM D-4192	Test Method for Potassium Water by Atomic Absorption
<u>American Concrete Institute, ACI</u>	
<u>Designation</u>	<u>Description</u>
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
TEX-418-A	Compressive Strength of Cylindrical Concrete Specimens

ITEM NO. 401S STRUCTURAL EXCAVATION AND BACKFILL 9-26-12

401S.1 Description

This item shall govern the excavation for placement of structures, except pipe sewers, the disposal of such excavated material and the backfill around completed structures to the level of the original ground or grade indicated on the Drawings. The work shall include all necessary pumping or bailing, sheathing, drainage, and the construction and removal of any required cofferdams. Unless otherwise indicated on the Drawings, the work included hereunder shall provide for the removal of old structures or portions thereof (abutments, buildings, foundations, wingwalls, piers, etc.), trees and all other obstructions necessary to the proposed construction.

Where excavation is not classified, it will be grouped under "Unclassified Structural Excavation", which shall include the removal of all materials encountered regardless of their nature or the manner in which they are removed.

Where excavation is classified, it shall be classed as "Common Structural Excavation" or "Rock Structural Excavation" in accordance with the following criteria:

"Common Structural Excavation" shall include the removal of all materials other than rock.

"Rock Structural Excavation" shall include the removal of firm and compact materials that cannot be excavated with power equipment, without first being loosened or broken by blasting, sledging or drilling.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

401S.2 Submittals

The submittal requirements of this specification item may include:

Supplier and certified test results for fine aggregate/sand material

Supplier and certified test results for flexible base material

Mix design and test results for lime stabilized subgrade material

Mix design and test results for Class J Concrete Base

Supplier and certified test results for granular material (coarse aggregate, foundation rock and pea gravel)

Mix design and test results for cement-stabilized backfill

Mix design and test results for controlled low strength material (CLSM)

Excavation Safety System Plan for proposed cofferdams, trench excavation and special shoring installations

401S.3 Materials

A. Sand

1. Fine aggregate sand shall be Grade 1 conforming to Standard Specification Item No. 302S, "Aggregates for Surface Treatments".
2. Native Sand shall be local material obtained from approved sources and subject to the approval of the Engineer or designated representative.

B. Flexible Base

Flexible base shall conform to the requirements of Standard Specification Item No. 210S, "Flexible Base".

C. Lime Stabilized Base

Lime stabilized base shall conform to the requirements of Standard Specification Item No. 202S, "Hydrated Lime and Lime Slurry" and Item No. 203S, "Lime Treatment for Materials in Place".

D. Concrete Base

Concrete base shall conform to a Class J Concrete as defined in Standard Specification Item No. 403S, "Concrete for Structures".

E. Granular Material

1. Coarse aggregate shall conform to the requirements of section 403S.3.C of Standard Specification Item No. 403S "Concrete for Structures".

2. Foundation Rock

Foundation rock shall be well graded, hard, durable coarse aggregate ranging in size from 2 to 6 inches (50 to 150 mm).

3. Pea Gravel

Pea gravel shall consist of hard, durable, opaque gravel, free of clay, loam, sand or other foreign substances, ranging in size from ¼ inch to ¾inch (6.4 to 9.5 mm) conforming to ASTM C 33.

F. Cement Stabilized Backfill

Cement stabilized backfill shall contain aggregate, water and a minimum of 7% hydraulic cement based on the dry weight of the aggregate in accordance with TxDOT Test Method Tex-120-E, "Soil-Cement Testing. Unless directed otherwise on the Drawings, the aggregate shall be clean sand approved by the Engineer or designated representative.

G. Controlled Low Strength Material

Controlled low strength material (CLSM) shall conform to Standard Specification Item No. 402S, "Controlled Low Strength Material" and shall be approved by the Engineer or designated representative.

401S.4 Construction Methods

A. Erosion Control and Tree Protection

Prior to commencement of this work, all required erosion control and tree protection measures indicated on the Drawings shall be in place. The existing utilities shall be located and protected as specified in the Standard Contract Documents, Section 00700, "General Conditions" and/or indicated on the Drawings. A permit shall be required when utility adjustments are to be made in preparation for construction in the right-of-way, as specified in Section 5.2.0 of the City of Austin Utilities Criteria Manual.

Areas within the construction limits indicated on the Drawings shall be cleared of all trees, stumps, brush, etc., except trees or shrubs scheduled for preservation which shall be carefully trimmed as directed by the Engineer or designated representative, in accordance with Standard Specification Item No. 610S, "Preservation of Trees and Other Vegetation" and shall be protected from scarring, barking or other injuries during construction operations. All exposed cuts over 2 inches (50 millimeters) in diameter, exposed ends of pruned limbs or scarred bark shall be treated with an approved asphalt material within 24 hours of the pruning or injury.

Construction equipment shall not be operated nor construction materials stockpiled under the canopies of trees, unless otherwise indicated on the Drawings and/or specified in the Contract Documents. Excavation or embankment materials shall not be placed within the drip line of trees until tree wells are constructed.

Within the construction limits or areas indicated, all obstructions, stumps, roots, vegetation, abandoned structures, rubbish and objectionable material shall be removed to the following depths:

1. In areas to receive 6 inches (150 mm) or more embankment, a minimum of 12 inches (300 mm) below natural ground.
2. In areas to receive embankment less than 6 inches (150 mm), a minimum of 18 inches (450 mm) below the lower elevation of embankment, structure or excavation.
3. In areas to be excavated a minimum of 18 inches (450 mm) below the lower elevation of the embankment, structure or excavation.
4. In all other areas a minimum of 12 inches (300 mm) below natural ground.

When abandoned storm drains, sewers or other drainage systems are encountered they shall be removed as required to clear the new structure and plugged in a manner approved by the Engineer or designated representative.

Holes remaining after removal of all obstructions, objectionable material, trees, stumps, etc. shall be backfilled with select embankment material and compacted by approved methods. All cleared and grubbed material shall be disposed of in a manner satisfactory to the Engineer or designated representative. Unless otherwise provided, all materials as described above shall become the property of the Contractor and removed from the site and disposed of at a permitted disposal site.

Burning materials at the site shall conform to Standard Contract Document Section 01550, "Public Safety and Convenience".

B. Excavation

1. Excavation shall be done in accordance with the lines and depths indicated on the Drawings or as established by the Engineer or designated representative. Unless otherwise indicated on the Drawings or permitted by the Engineer or designated representative no excavation shall be made outside a vertical plane 3 feet (0.9 meter) from the footing lines and parallel thereto.

When structures are installed in streets, highways or other paved areas, the pavement and base shall be cut to neat lines. After completion of the excavation and backfilling, the pavement structure shall be restored to the satisfaction of the Engineer or designated representative.

2. Slopes, benching, sheeting, bracing, pumping and bailing shall be provided as necessary to maintain the stability and safety of excavations up to 5 feet (1.5 meters) deep. Excavation protection for excavations deeper than 5 feet (1.5 meters) shall be governed by Standard Specification Item No. 509S, "Excavation Safety Systems".
3. Excavation shall conform to elevations indicated on the Drawing or raised or lowered by written order of the Engineer or designated representative, when such alterations are judged proper. When it is deemed necessary to increase or decrease the plan depth of footings, the alterations in the details of the structure shall be as directed by the Engineer or designated representative. The Engineer or designated representative shall have the right to substitute revised details resulting from consideration of changes in the design conditions.
4. When a structure is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation and the final excavation to grade shall not be performed until just before the footing is placed. Equipment selected and used by the Contractor for excavation which results in disturbance of what was otherwise stable subgrade material, as shown by laboratory tests,

will not be used as a justification for payment for excavating to extra depth or for payment for stabilizing materials which may be ordered by the Engineer or designated representative.

5. Excavated material required to be used for backfill may be deposited by the Contractor in storage piles as indicated on the Drawing or at points convenient for its rehandling during the backfilling operations, subject to the approval of the Engineer or designated representative, who may require that the survey center line of the structure and the transverse or hub line of any unit of the structure be kept free of any obstruction. The Contractor shall adjust any stockpiles, to facilitate surveying and the work of other Contractors working in the immediate proximity, as directed by the Engineer or designated representative.
6. Excavated material required to be wasted shall be disposed of as directed by the Engineer or designated representative, in a manner which will not obstruct the stream or otherwise impair the efficiency or appearance of the structure or other part of the work.
7. For all single and multiple box culverts, pipe culverts, pipe arch culverts and box sewers of all types, where the soil encountered at established footing grade is a quicksand, muck or similar unstable material, the following procedure shall be used unless other methods are indicated:
 - a) The depth to which unstable material is removed will be determined by the Engineer or designated representative. It will not exceed 2 feet (0.6 meter) below the footing of culverts that are 2 feet (0.6 meter) or more in height and will not exceed the height of culverts for those less than 2 feet (0.6 meter) high. Excavation shall be carried at least 1 foot (0.3 meter) horizontally beyond the limits of the structure on all sides. All unstable soil removed shall be replaced with suitable stable material, in uniform layers of suitable depth for compaction as directed by the Engineer or designated representative. Each layer shall be wetted, if necessary and compacted by rolling or tamping as required to provide a stable foundation for the structure. Soil, which has sufficient stability to properly sustain the adjacent sections of the roadway embankment, will be considered a suitable foundation material.
 - b) When, in the opinion of the Engineer or designated representative, it is not feasible to construct a stable footing as outlined above, the Contractor shall construct it by the use of special materials, such as flexible base, cement stabilized base, cement stabilized rockfill or other material, as directed by the Engineer or designated representative. This work will be paid for as provided in Section 401S.9, "Payment".
8. When the material encountered at footing grade of a culvert is found to be partially rock or incompressible material and partially a compressible soil which is satisfactory for the foundation, the incompressible material shall be removed for a depth of 6 inches (150 mm) below the footing grade and backfilled with a compressible material similar to that used for the rest of the structure.
9. When the material encountered at footing grade of a bridge bent or pier is found to be partially of rock or incompressible material, and partially of a compressible material, the foundation shall not be placed until the Engineer or designated representative has inspected the footing and authorized such changes found necessary to provide an adequate foundation.

401S.5 Bridge Foundations and Retaining Walls

The material below the bottom of the footing grade shall not be disturbed. Backfill material shall not be used to compensate for excavation that is extended below the proposed footing grade. When excavation is carried below the proposed footing grade, the over excavated area shall be filled with concrete at the time the footing is placed. The additional concrete placement shall be at the Contractor's sole expense.

When required by the Engineer or designated representative, cores shall be taken to determine the character of the supporting material(s). The cores shall be taken when the excavation is nearing completion and shall be an intact sample adequate to judge the character of the founding material. The cores shall be acquired at a minimum depth of 5 feet (1.5 meters) below the proposed footing founding grade.

When the founding stratum is rock or other hard material, all loose material shall be removed and the founding grade cleaned and cut to a firm surface that is level, stepped or serrated as directed by the Engineer or designated representative. All soft seams shall be cleaned and filled with concrete at the time the footing is placed.

When the material at the footing grade of a retaining wall, bridge bent or pier is a mixture of compressible and incompressible material, the foundation shall not be placed until the Engineer or designated representative has inspected the excavation and authorized changes to provide a uniform bearing condition.

401S.6 Cofferdams

The term cofferdams, whenever used in this specification, designates any temporary or removable structure constructed to hold the surrounding earth, water or both, out of the excavation, whether the structure is formed of earth, timber, steel, concrete or a combination of these. It includes earthen dikes, timber cribs, any type of sheet piling, removable steel shells and the like and all necessary bracing and it shall be understood also to include the use of pumping wells or well points for de-watering. The cost of cofferdams, when required, shall be included as a part of the bid price for excavation.

It is the intent of this specification to require that a suitable cofferdam be provided, when necessary, to insure that the foundation may be placed in a dry condition, as to preclude sliding and caving of the walls of the excavation. The cofferdam shall conform with the requirements of Standard Specification Item No. 509S, "Excavation Safety Systems" and shall provide a safe work area with sufficient clearance for the construction, inspection and removal of required forms and, if necessary, sufficient room to allow pumping outside the forms. Where no ground or surface water is encountered, the cofferdam need be sufficient only to protect the workers and to avoid cave-ins or slides beyond the excavation limits.

Unless otherwise indicated on the Drawings, cofferdams shall be removed by the Contractor after the completion of the substructure without disturbing or marring the structure.

401S.7 De-Watering

Structures shall not be constructed or placed in the presence of water unless otherwise approved by the Engineer or designated representative. Precast members, pipe and concrete shall only be placed on a dry, firm surface. Water shall be removed by bailing, pumping, well-point installation, deep wells, underdrains or other approved method.

When structures are approved for placement in the presence of water, standing water shall be removed in a manner that shall preclude the possibility of the movement of water through or alongside any concrete being placed. Pumping or bailing will not be permitted during the placing of concrete or for a period of at least 36 hours thereafter, unless from a suitable sump separated from the concrete work by a water-tight wall.

Pumping or bailing during placement of seal concrete shall only be allowed to the extent necessary to maintain a static head of water within the cofferdam. De-watering inside a sealed cofferdam shall not commence until the seal has aged a minimum of 36 hours.

When the bottom of an excavation cannot be de-watered to the point that the subgrade is free of mud or it is difficult to keep the reinforcing steel clean a stabilizing material (e.g. flexible base, cement-stabilized-backfill or lean concrete) shall be placed in the bottom of the excavation. When a lean concrete is used, the concrete shall include a minimum of 275 Pounds of cement per cubic yard (163 kilograms of cement per cubic meter) and be

placed to a minimum depth of 3 inches (75 mm). Stabilizing material that is placed for the convenience of the Contractor will be at the Contractor's own expense.

401S.8 Backfilling

A. General

As soon as practicable, all portions of excavation not occupied by the permanent structure shall be backfilled. Back-fill material shall be free from stones large enough to interfere with compaction, large or frozen lumps that will not break down readily under compaction, wood or other extraneous material. Backfill material shall be approved by the Engineer or designated representative.

That portion of backfill which will support any portion of completed roadbed, retaining wall or embankment shall be placed in layers not more than 8 inches (200 mm) in depth (loose measurement) and shall be compacted to meet the density requirements of the roadbed, retaining wall, embankment material, or as indicated on the Drawings.

That portion of backfill which will not support any portion of completed roadbed or embankment shall be placed in layers not more than 10 inches (250 mm) in depth (loose measurement) and shall be compacted to a minimum of 95 percent of maximum density as determined by TxDOT Test Method Tex-114-E and the re-excavated to the proper grade and dimensions.

If the excavation has been made through a hard material resistant to erosion, the backfill around piers and in front of abutments and wings may be ordered by the Engineer or designated representative to be of stone or lean concrete. Unless otherwise indicated on the Drawings, such backfill shall be paid for as extra work.

That portion of the backfill which will support any portion of the roadbed, retaining wall or embankment shall be placed in uniform layers not more than 8 inches (200 mm) in depth (loose measurement) and shall be compacted to a minimum of 95 percent of maximum density, as determined by TxDOT Test Method Tex-114-E and then re-excavated to the proper grade and wetted uniformly to the moisture content required to obtain the specified density and shall be compacted to that density by means of mechanical tampers or rammers, except that the use of rolling equipment of the type generally used in compaction embankments will be permitted on portions which are accessible to such equipment.

All portions of embankment too close to any portion of a structure to permit compaction by the use of the blading and rolling equipment used on adjoining sections of embankment, shall be placed and compacted with mechanical tamps and rammers to avoid damage to the structure.

These provisions require mechanical compaction by means of either rolling equipment or mechanical tampers or rammers, of all backfill and embankment adjoining the barrels and wingwalls or culverts and adjoining all sides of bridge abutments and retaining walls, regardless of whether or not such embankment or backfill is above or below the original surface of the ground and regardless of whether the excavation at structure site was performed conforming to Standard Specification Item No.111S, "Excavation", this item 401S, "Structural Excavation", Standard Specification Item No. 110S, "Street Excavation" or Standard Specification Item No. 120S, "Channel Excavation". Unless otherwise indicated on the Drawings, hand tamping will not be accepted as an alternate for mechanical compaction.

As a general rule, material used in filling or backfilling the portions described in this paragraph shall be an earth, free of any appreciable amount of gravel or stone particles larger than 4 inches (100 mm) in greater dimension and of a gradation that permits thorough compaction. When, in the opinion of the Engineer or designated representative, such material is not readily available, the use of rock or gravel mixed with earth will be permitted, provided that no particles larger than 12 inches (300 mm) or smaller than 6 inches (150 mm) may be used. The percentage of fines shall be sufficient to fill all voids and insure a uniform and

thoroughly compacted mass of proper density. When required by the Drawings or by written order of the Engineer or designated representative, cement-stabilized-backfill material shall be used for backfilling.

All portions of fill and backfill described in the preceding paragraph shall be compacted to the same density requirements specified for the adjoining sections of embankment in accordance with the governing specifications. Where no embankment is involved on the project and no relevant specifications are included in the contract, all backfill shall be compacted to a density comparable with the adjacent undisturbed material.

No backfill shall be placed against any abutment or retaining wall until such structure has been in place at least 7 days. No backfill shall be placed adjacent to or over single and multiple boxes until the top slab has attained 500 psi (3450 kPa) flexural strength. Backfill placed around abutments and piers shall be deposited on both sides to approximately the same elevation at the same time.

Care shall be taken to prevent any wedging action of backfill against the structure and the slopes bounding the excavation shall be stepped or serrated to prevent such action. Backfill shall be uniformly placed around bridge foundations.

B. Pipe Culverts

The following requirements shall apply to the backfilling of pipe culverts in addition to the pertinent portions of the general requirements given in the preceding section.

Selected materials from excavation, borrow or other approved material shall be wetted, if required and placed along both sides of the pipe equally, in uniform layers not exceeding 8 inches (200 mm) in depth (loose measurement) and thoroughly compacted so that there shall be a berm of thoroughly compacted material on each side of the pipe. The method and degree of compaction shall be the same as specified above for portions of backfill within the limits of embankment or roadbed.

Filling and/or backfilling shall be continued in this manner to the elevation of the top of the pipe. Special care shall be taken to secure thorough compaction of the material placed under the haunches of the pipe to prevent damage or displacement of the pipe. All fill or backfill below the top of pipe shall be compacted mechanically in the manner and to the density prescribed above, regardless of whether or not such material is placed within the limits of the embankment or roadbed. In the case of pipe placed in trenches, that portion of the backfill above the top of the pipe which supports embankment or the roadbed shall receive mechanical compaction as specified above and the portion which will not support any portion of embankment or roadbed shall be placed in layers not more than 8 inches (200 mm) in depth (loose measurement) and shall be compacted by whatever means the Contractor chooses, to a density comparable with the adjacent, undisturbed material. Embankments above the top of pipe shall be placed conforming to Item No. 132S, "Embankment". During construction adequate cover must be provided to protect the structure from damage.

The Engineer or designated representative may reject backfill material that contains more than 20% by weight of material retained on a 3-in (75 mm) sieve, with large lumps not easily broken down, or that cannot be spread in loose layers. Material excavated by a trenching machine will generally meet the requirements of this Section as long as large stones are not present.

Where pipe extends beyond the toe of slope of the embankment and the depth of cover provided by backfill to the original ground level is less than the minimum required by the specifications for the type of pipe involved, additional material shall be placed and compacted until the minimum cover has been provided.

Whenever excavation is made for installing pipe culverts or box sewers across private property or beyond the limits of the embankment, the top soil removed in excavating the trench shall be kept separate and replaced as nearly as feasible in its original position and the entire area involved in the construction operations shall be restored to a presentable condition.

C. Cement Stabilized Backfill

When indicated on the Drawings, trenches shall be backfilled to the elevations shown with cement stabilized backfill. The cement-stabilized backfill shall be placed equally along the sides of structures to prevent strain on or displacement of the structure.

Cement stabilized backfill below the spring line of pipe culverts shall be sufficiently plastic to completely fill all voids in the trench. Hand operated tampers may be used if necessary to fill the voids. The pipe shall be held in alignment by jacks or other suitable means to prevent the mortared joints from cracking due to displacement caused by placing the backfill material.

Cement stabilized backfill above the spring line of pipe culverts may be dry enough to be transported without special mixing equipment.

On structures other than pipe culverts, special mixing equipment will not be required to transport the cement stabilized backfill unless otherwise indicated on the Drawings.

D. Controlled Low Strength Material (CLSM)

When indicated on the Drawings the excavation shall be backfilled with CLSM to the elevations shown. The structure shall be prevented from being displaced or "floated out" during the placement of CLSM. The CLSM shall be prevented from entering culverts and drainage structures.

401S.9 Measurement

Unless otherwise indicated on the Drawings, structural excavation for pipe headwalls, inlets, manholes, culvert widening (extensions), bridge abutments and side road and private entrance pipe culverts will not be measured in the field but shall be included in the Plan Quantity unit price bid by the cubic yard (cubic meters: 1 cubic meter is equal to 1.308 cubic yards) Determination of plan quantities for structural excavation shall be made by the method of average end-areas using the following limits to establish templates for measurement.

- A. For all structures requiring measurement, except the barrels of pipe culverts, no material outside of vertical planes 1 foot (300 mm) beyond the edges of the footings and parallel thereto will be included.
- B. For the barrels of pipe culverts of 42 inches (1.09 meters) or less nominal or equivalent diameter, no material outside of vertical planes 1 foot (300 mm) beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included. For the barrels of pipe culverts more than 42 inches (1.09 meters) in nominal or equivalent diameter, no material outside of vertical planes located 2 feet (600 mm) beyond the horizontal projection of the outside surfaces of the pipe and parallel thereto will be included.
- C. If a cofferdam, as herein defined, is used, the limitations indicated above shall apply just as if no cofferdams were used.
- D. Where excavation in addition to that allowed for the footings is required for other portions of the structure, such as for the cap, cross strut or tie beam of a pier or bent or for the superstructure, measurements for such additional excavation will be limited laterally by vertical planes 1 foot (300 mm) beyond the face of the member and parallel thereto and vertically to a depth of 1 foot (300 mm) below the bottom of such member.
- E. Except as allowed by the above conditions, no account will be taken of any excavation necessary for placing forms or falsework.
- F. Except at side road culverts, all street excavation called for on the contract drawings at all structure sites shall be assumed to be completed before starting the structural excavation and the measurement of structural excavation will include only material below or outside the limits of the completed street excavation. Excavation for side road and private entrance pipe culverts will not be measured for payment but shall be included in the unit price bid for this specification item.

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- G. On all structures of bridge classification where the contract drawings call for channel excavation at the structure site, it shall be assumed to have been completed before starting the structural excavation and the measurement of structural excavation will include only material below or outside the limits of the completed channel section. The method of measurement for payment will be in accordance with this procedure regardless of the actual construction methods followed.
 - H. Where excavation diagrams are indicated on the Drawings, they shall take precedence over these provisions.
 - I. Measurement will not include materials removed below footing grades to compensate for anticipated swellage due to pile driving and it will not include material required to be removed due to swellage beyond the specified limits during pile driving operations.
 - J. Measurement will not include additional yardage caused by slips, slides, cave-ins, siltings or fillings due to the action of the elements or the carelessness of the Contractor. Water will not be classed as excavated material.
 - K. Where rock, other incompressible or unstable material is undercut to provide suitable foundation for pipe or box culverts, such material below grade, ordered by the Engineer or designated representative to be removed, will be measured for payment.
 - L. Except for any required undercut, quantities for "Structural Excavation", as indicated on the Drawings, shall be considered as final quantities and no further measurement will be required, unless the alignment, grades or structure locations are revised by the Engineer or designated representative during construction. Final determination of quantities for individual structures will be made, if in the opinion of the Engineer or designated representative or upon evidence furnished by the Contractor, substantial variations exist between quantities indicated on the Drawings and actual quantities due to changes in cross sections or apparent errors. Excavation quantities for foundations indicated on the Drawings where cofferdams are required shall be considered as final quantities and no further measurement will be made.
 - M. For any footing, foundation or other structure unit within the scope of this specification, additional measurement will be made of the volume of excavation involved in the lowering or raising of the elevation of a footing, foundation or structure unit, when such grade change is authorized by the Engineer or designated representative. Measurement will be made by the addition to or the deduction from, the original quantities for the volume of excavation involved in the authorized grade change.
 - N. Cement stabilized backfill shall be measured by the backfill diagram as indicated on the Drawings. The quantity of "Cement Stabilized Backfill" as indicated on the Drawings shall be considered as final quantities and no further measurement will be required, unless alignment or grade elevations as indicated are revised by the Engineer or designated representative. If such revisions result in an increase or decrease in this quantity, the final quantity will be revised by the amount represented by the changes in alignment or grade elevations.

401S.10 Payment

Payment for all work prescribed under this item and measured as provided above will be made at the unit bid price per cubic yard for the particular class of excavation specified on the Drawings in the amount shown on the Drawings and in the proposal. Payment for revised quantities will be made as specified above and for the removal of unstable and incompressible material as noted below.

Payment for removal and replacement of unstable or incompressible material below the footing grades of culverts and box sewers as indicated above will be made as follows:

When indicated on the Drawings or the Engineer or designated representative directs the use of special materials such as flexible base, concretebase, cement stabilized backfill, controlled low strength material or other special material, payment for excavation below the footing grades shall be made at the unit bid price for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation", as the case may be.

Payment for furnishing, hauling, placing and compacting the flexible base, concrete base, cement stabilized backfill, controlled low strength material or other special material will be made at the unit bid price for these items in the bid or in accordance with pertinent provisions for extra work.

Where special materials are not required or specified, the removal and replacement of the unstable material will be performed as described above. Payment therefore will be made at a price equal to 200 percent of the unit bid price per cubic yard for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation", as the case may be. The unit bid price shall include full compensation for removing the unstable or incompressible material, for furnishing, hauling, placing and compacting suitable material required to replace it and for all labor, equipment, tools and incidentals necessary to complete the work.

Payment for "Concrete Base", "Cement Stabilized Backfill" and "Controlled Low Strength Material" measured as prescribed above shall be made at the unit bid price per cubic yard. The unit bid price shall include full compensation for furnishing all materials, tools, labor, equipment, sheathing and incidentals required to perform the applicable work prescribed herein.

When the Engineer or designated representative judges it necessary to lower the structure footings to an elevation below the grade indicated on the Drawings, payment for the "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation" as the case may be, required below plan grade down to and including an elevation 5 feet (1.525 meters) below drawing grade for any individual footing will be made at a unit price equal to 115 percent of the contract unit bid price. Payment for the excavation from an elevation over 5 feet (1.525 meters) below plan grade down to and including an elevation 10 feet (3.05 meters) below plan grade will be made at a unit price equal to 125 percent of the contract unit bid price for "Unclassified Structural Excavation", "Common Structural Excavation" or "Rock Structural Excavation" as the case may be. No increase in unit price will be allowed for other bid items of the contract and no additional compensation will be allowed for any required cofferdam adjustments made necessary by such lowering of footings. These provisions shall not apply to the lowering of culverts, except when the flow line grade is lowered 1 foot (300 mm) or more below plan grade.

In cases where the extra depths required for any footing or footings exceeds 10 feet (3.05 meters), a supplemental agreement shall be made covering the quantities removed from depths in excess of 10 feet (3.05 meters) below plan grade.

No direct payment will be made for filling or backfilling around structures. Payment for the backfilling and compacting of areas, which were removed as structural excavation shall be included in the unit bid prices for the various classes of structural excavation.

At the end of each estimate period, the Engineer or designated representative shall determine the completed portion of the total work under Standard Specification Item No. 401S "Structural Excavation and Backfill" and payment shall be made accordingly.

Filling or backfilling of areas above the natural ground level or above the limits of street excavation or channel excavation sections shall be considered as Standard Specification Item No. 132S, "Embankment" and payment therefore shall be included in the unit prices bid for the various classes of Standard Specification Item No. 110S, "Street Excavation", Standard Specification Item No. 120S, "Channel Excavation" or Standard Specification Item No. 130S, "Borrow".

Where no channel excavation is provided for at culvert sites and where it is necessary to excavate beyond the limits of structural excavation, as herein described in order that the culvert may function properly, such excavation shall be included with structural excavation as may be indicated on the Drawings.

Payment for all work prescribed under this item shall include full compensation for all excavation and backfill including compaction, all soundings, construction of all cofferdams, all dewatering and for furnishing all materials, labor, equipment, tools, sheathing, bracing, cofferdams, pumps, drills, explosives and incidentals necessary to complete the work, except for specific allowances stated above.

Special materials used or additional excavation made for the Contractor's convenience to expedite the work will not be paid for directly, but shall be included in the unit price bid for this specification item. In addition, if the Contractor's construction methods and equipment creates conditions necessitating usage of special materials or additional excavation, the work and materials will not be paid for directly, but shall be included in the unit price bid for this specification item.

When specified in the contract bid form as a separate pay item(s), the item(s) will be paid for at the contract unit price(s) for "Flexible Base", "Lime Stabilized Base" and "Controlled Low Strength Material". The bid prices shall include full compensation for all Work herein, specified, including the disposal of all material not required in the Work, the furnishing of all material, equipment, tools, labor and incidentals necessary to complete the Work.

Payment will be made under one of the following:

Pay Item No. 401S-A:	Unclassified Structural Excavation, Plan Quantity	Per Cubic Yard.
Pay Item No. 401S-B:	Common Structural Excavation	Per Cubic Yard.
Pay Item No. 401S-C:	Rock Structural Excavation	Per Cubic Yard.
Pay Item No. 401S-D:	Concrete Base	Per Cubic Yard.
Pay Item No. 401S-E:	Cement Stabilized Backfill	Per Cubic Yard.
Pay Item No. 401S-F:	Flexible Base	Per Cubic Yard.
Pay Item No. 401S-G:	Lime Stabilized Base	Per Square Yard.
Pay Item No. 401S-H:	Controlled Low Strength Material	Per Cubic Yard.
Pay Item No. 401S-I:	Cofferdams, type	Per Cubic Yard.
Pay Item No. 401S-J:	Dewatering	Per Cubic Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Standard Specification Item 401S, "Structural Excavation and Backfill"</u>	
<u>City of Austin Standard Contract Documents</u>	
<u>Designation</u>	<u>Description</u>
Section 00700	General Conditions
Section 01550	Public Safety and Convenience
<u>City of Austin Utilities Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 5.2.0	Permit Information and Format
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 130S	Borrow
Item No. 132S	Embankments
Item No. 202S	Hydrated Lime and Lime Slurry
Item No. 203S	Lime Treatment for Materials in Place
Item No. 210S	Flexible Base
Item No. 302S	Aggregates for Surface Treatments
Item No. 402S	Controlled Low Strength Material

Item No. 403S	Concrete for Structures
Item No. 509S	Excavation Safety Systems
Item No. 610S	Preservation of Trees and Other Vegetation
<u>Texas Department of Transportation: Departmental Material Specifications</u>	
<u>Designation</u>	<u>Description</u>
DMS-4640	Chemical Admixtures for Concrete
<u>American Society for Testing and Materials, ASTM</u>	
<u>Designation</u>	<u>Description</u>
ASTM C 33	Specification For Concrete Aggregates
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-114-E	Laboratory Compaction Characteristics & Moisture-Density Relationship of Subgrade & Embankment Soil
Tex-120-E	Soil-Cement Testing

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item 401S, "Structural Excavation and Backfill"</u>	
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 110	Excavation
Item 132	Embankment
Item 400	Excavation and Backfill for Structures
Item 401	Flowable Backfill
Item 402	Trench Excavation Protection
Item 403	Temporary Special Shoring
Item 421	Hydraulic Cement Concrete

ITEM NO. 403S CONCRETE FOR STRUCTURES 9-26-12

403S.1 Description

This item shall govern quality, storage, handling, proportioning and mixing of materials for hydraulic cement concrete construction of buildings, bridges, culverts, slabs, prestressed concrete and incidental appurtenances.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

403S.2 Submittals

The submittal requirements of this specification item may include:

- A. Mix design option(s) of the class of concrete required on the project,
- B. The supplier of the concrete mix design(s) and type of mixing equipment, and
- C. Type of admixtures to be used with the concrete mixes.

403S.3 Materials

Concrete shall be composed of hydraulic cement or hydraulic cement and supplementary cementing materials, water, aggregates (fine and coarse), and admixtures proportioned and mixed as hereinafter provided to achieve specified results.

A. Cementitious Materials

Hydraulic cement shall conform to ASTM C 150, Type I (General Purpose), Type II (General Purpose with Moderate Sulfate Resistance) and Type III (High Early Strength). Type I shall be used when none is specified or indicated on the drawings. Type I and Type III cements shall not be used when a Type II cement is specified or indicated on the drawings. Type III cement may be used in lieu of a Type I cement, when the anticipated air temperature for the succeeding 12 hours will not exceed 60°F (15.6°C). A Type III cement shall only be used in precast concrete or when otherwise specified or allowed. All cement shall be of the same type and from the same source for a monolithic placement.

Unless otherwise specified the cementitious material content shall be limited to no more than 700 lbs. per cubic yard (417 kg per cubic meter). When supplementary cementing materials are used, cement is defined as "cement plus supplementary cementing material." Supplementary cementing materials include fly ash (DMS 4610), ultra-fine fly ash (DMS-4610), ground granulated blast furnace slag grade 100 or 120 (DMS-4620), silica fume (DMS-4630) and metakaolin (DMS-4635).

Supplementary cementing materials shall not be used when white hydraulic cement is specified.

Class C flyash shall not be used in sulfate-resistant concrete.

Hydraulic cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Commission on Environmental Quality (TCEQ) and the U.S. Environmental Protection Agency (EPA). Supplier shall provide current TNRC and EPA authorizations to operate the facility.

When sulfate-resistant concrete is required for a project, mix design options 1, 2, 3 or 4 presented in Section 403S.8, "Mix Design Options" shall be used to develop appropriate mix design utilizing Type I/II, II, V, IP or IS cement.

B. Mixing Water

Water for use in concrete and for curing shall be potable water free of oils, acids, organic matter or other deleterious substances and shall not contain more than 1,000 parts per million of chlorides as Cl or sulfates as SO₄.

Water from the City of Austin will not require testing. Contractor may request approval of water from other sources. Contractor shall arrange for samples to be taken from the source and tested at the Contractor's expense. When water from other sources is proposed, test reports shall be provided that indicates compliance with Table 1 before use.

Contaminant	Test Method	Maximum Concentration (ppm)
Chloride (CL)	ASTM D-512	500
Prestressed concrete		
Bridge decks & superstructure		
All other concrete		1,000
Sulfate (SO ₄)	ASTM D-516	1,000
Alkalies (NA ₂ O + 0.658 K ₂ O)	ASTM D-4191 & D-4192	600
Total Solids	AASHTO T-26	50,000

Water that has an adverse effect on the air-entraining agent or any other chemical admixture or on strength or time of set of the concrete shall not be used. Water used in white Portland cement concrete shall be free from iron and other impurities, which may cause staining, or discoloration.

C. Coarse Aggregate

Coarse aggregate shall consist of durable particles of crushed or uncrushed gravel, crushed blast furnace slag, crushed stone or combinations thereof; free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material either free or as an adherent coating. When white hydraulic cement is specified, the coarse aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout.

The coarse aggregate from each source shall not contain more than 0.25 percent by weight of clay lumps, nor more than 1.0 percent by weight of shale nor more than 5 percent by weight of laminated and/or friable particles when tested in accordance with TXDOT Test Method TEX-413-A. The coarse aggregate from each source shall have a wear of not more than 40 percent when tested in accordance with TXDOT Test Method TEX-410-A.

Unless otherwise indicated on the drawings, the coarse aggregate from each source shall be subjected to 5 cycles of the soundness test conforming to TXDOT Test Method TEX-411-A. The loss shall not be greater than 12 percent when sodium sulfate is used or 18 percent when magnesium sulfate is used.

Coarse aggregate shall be washed. The Loss by Decantation (TXDOT Test Method TEX-406-A), plus allowable weight of clay lumps, shall not exceed 1 percent or the value indicated on the drawings or in the project manual, whichever is less. If material finer than the # 200 (75 micrometer) sieve is definitely established to be dust of fracture of aggregates made primarily from crushing of stone, essentially free from clay or shale as established by Part III of TXDOT Test Method TEX-406-A, the percent may be increased to 1.5. When crushed limestone coarse aggregate is used in concrete pavements, the decant may exceed 1% but not more than 3%

if the material finer than the #200 (75 micrometer) sieve is determined to be at least 67% calcium carbonate in accordance with TxDOT Test Method Tex-406-A, Part III.

The coarse aggregate factor may not be more than 0.82; however, when voids in the coarse aggregate exceed 48 percent of the total rodded volume, the coarse aggregate factor shall not exceed 0.85. The coarse aggregate factor may not be less than 0.68 except for a Class I machine extruded mix that shall not have a coarse aggregate factor lower than 0.61.

When exposed aggregate surfaces are required, the coarse aggregate shall consist of particles with at least 40 percent crushed faces. Uncrushed gravel, polished aggregates and clear resilient coatings are not acceptable for exposed aggregate finishes.

When tested by approved methods, the coarse aggregate including combinations of aggregates when used, shall conform to the grading requirements shown in Table 2.

Grade	Nom. Size	2½" (62.5mm)	2" (50mm)	1½" (37.5mm)	1" (25mm)	¾" (19mm)	½" (12.5mm)	⅜" (9.5mm)	No. 4 (4.75mm)	No. 8 (2.36mm)
1	2" (50 mm)	100	80—100	50—85		20—40			0—5	
2 (467)*	1½" (37.5 mm)		100	95—100		35—70		10—30	0—5	
3	1" (50 mm)		100	95—100		60—90	25—60		0—5	
4 (57)*	1" (50 mm)			100	95—100		25—60		0—10	0—5
5 (67)*	¾" (19 mm)				100	90—100		20—55	0—10	0—5
6 (7)*	½" (12.5 mm)					100	90—100	40—70	0—15	0—5
7	⅜" (9.5 mm)						100	70—95	0—25	
8	⅜" (9.5 mm)						100	95—100	20—65	0—10

Notes:

1. Recycled crushed concrete fine aggregate shall be limited to a maximum of 20% of the fine aggregate.
2. The use of recycled crushed hydraulic cement concrete as a coarse aggregate shall be limited to Concrete Classes A, B and D (see Table 5).

D. Fine Aggregate

Fine aggregate shall be washed and consist of clean, hard, durable and uncoated particles of natural or manufactured sand or a combination thereof, with or without a mineral filler. When white hydraulic cement is specified, the fine aggregates used in the concrete shall be light colored. Quality shall be reasonably uniform throughout. It shall be free from frozen material or injurious amounts of salt, alkali, vegetable matter or other objectionable material and it shall not contain more than 0.5 percent by weight of clay lumps in accordance with TEX-413-A. When subjected to color test for organic impurities per TXDOT Test Method TEX-408-A, it shall not show a color darker than standard.

Unless indicated otherwise on the drawings the acid insoluble residue of fine aggregate used in slab concrete subject to direct traffic shall not be less than 60 percent by weight (mass) when tested conforming to TXDOT Test Method TEX-612-J.

Unless indicated otherwise on the Drawings, fine aggregate shall be blended, when necessary, to meet the acid insoluble residue requirement.

When blending the following equation shall be used:

$$\text{Acid Insoluble (\%)} = \frac{(A1)(P1) + (A2)(P2)}{100}$$

Where:

A1 = acid insoluble (%) of aggregate 1,

A2 = acid insoluble (%) of aggregate 2,

P1 = % by weight of A1 of the fine aggregate blend, and

P2 = % by weight of A2 of the fine aggregate blend.

When tested in accordance with TxDoT Test Method Tex-401-A, the fine aggregate, including mineral filler and combinations of aggregates, when used, shall conform to the grading requirements shown in Table 3.

¾(9.5 mm)	No. 4 (4.75 mm)	No. 8 (2.36 mm)	No. 16 (1.18mm)	No. 30 (600 µm)	No. 50 (300 µm)	No. 100 (150 µm)	No. 200 (75 µm)
100	95—100	80—100	50—85	25—65	10—35	0—10	0—32

Notes:

1. Recycled crushed concrete fine aggregate shall be limited to a maximum of 20% of the fine aggregate.
2. The use of recycled crushed hydraulic cement concrete as a fine aggregate shall be limited to Concrete Classes A, B and D (see Table 5).
3. 6 to 35 when sand equivalent value is greater than 85.
4. 0 to 6 for manufactured sand.

Sand equivalent per TXDOT Test Method TEX-203-F shall not be less than 80 nor less than otherwise indicated on the drawings, whichever is greater.

The fineness modulus will be determined by adding the percentages by weight retained on sieve Nos. 4, 8, 16, 30, 50 and 100 (4.75 mm, 2.36 mm, 1.18mm, 600 µm, 300 µm, and 150 µm) and dividing the sum of the six sieves by 100. For all classes of concrete except K (see Table 5), the fineness modulus shall be between 2.30 and 3.10. For Class K concrete, the fineness modulus shall be between 2.40 and 2.90, unless indicated otherwise on the Drawings.

E. Mineral Filler

Mineral filler shall consist of stone dust, clean crushed sand or other approved inert material. When tested in accordance with TxDoT Test Method Tex-401-A, it shall conform to the following gradation:

Passing the No. 30 (600 µm) Sieve	100 percent
Passing the No. 200 (75 µm) Sieve	65 to 100 percent

F. Mortar and Grout

Unless otherwise specified, indicated on the drawings or approved by the Engineer or designated representative mortar and grout shall consist of 1 part cement, 2 parts finely graded sand and enough water to make the mixture plastic. When required to prevent color difference, white cement shall be added to produce color required. When required by the Engineer or designated representative, approved latex adhesive may be added to the mortar. Mortar shall be provided with a consistency such that the mortar can be easily handled and spread by trowel. Grout shall be provided of a consistency that will flow into and completely fill all voids.

G. Admixtures

All chemical admixtures including water reducing, plasticizers and air entrainment shall conform to TxDoT DMS-4640, "Chemical Admixtures for Concrete". Calcium chloride-based admixtures shall not be approved. Admixtures shall be included in the prequalified concrete admixtures list maintained by TxDoT's Construction Division. High-range water-reducing admixtures (TxDoT Type F or G) and accelerating admixtures (TxDoT Type C or E) shall not be used in bridge deck concrete.

H. Air Entrainment

Unless indicated otherwise on the drawings, all concrete classes with the exception of Class B shall be air entrained in accordance with Table 8. If the air content is more than 1½ percentage points below or 3 percentage points above the required air, the load of concrete will be rejected. If the air content is more than 1½ but less than 3 percentage points above the required air, the concrete may be accepted based on strength test results.

403S.4 Storage of Materials

A. Cement, Supplementary Cementing Materials and Mineral Filler

All cement, supplementary cementing materials and mineral filler shall be stored in separate and well ventilated, weatherproof buildings or approved bins, which will protect the material from dampness or absorption of moisture. Storage facilities shall be easily accessible and each shipment of packaged cement shall be kept separated to provide for identification and inspection. The Engineer or designated representative may permit small quantities of sacked cement to be stored in the open for a maximum of 48 hours on a raised platform and under waterproof covering.

B. Aggregates

The method of handling and storing concrete aggregates shall prevent contamination with foreign materials. If the aggregates are stored on the ground, the sites for the stockpiles shall be clear of all vegetation and shall be level. Aggregates shall be stockpiled in sizes to facilitate blending. If the aggregate is not stockpiled on a hard, non-contaminant base, the bottom 6-inch (150 mm) layer of the stockpile shall not be used without recleaning the aggregate.

When conditions require the use of 2 or more grades of coarse aggregates, separate stockpiles shall be maintained to prevent intermixing. Where space is limited, stockpiles shall be separated by walls or other appropriate barriers.

Aggregate shall be stockpiled and protected from the weather a minimum of 24 hours prior to use to minimize free moisture content. When stockpiles are too large to protect from the weather, accurate and continuous means acceptable to the Engineer or designated representative shall be provided to monitor aggregate temperature and moisture. Aggregates shall be stockpiled and handled such that segregation and contamination are minimized.

The stockpiles shall be sprinkled to control moisture and temperature as necessary. A reasonably uniform moisture content shall be maintained in aggregate stockpiles.

C. Admixtures

Admixtures shall be stored in accordance with manufacturer's recommendations and shall be protected against freezing.

D. Hot Weather Concrete Mixes

Ice may be used during hot weather concrete placement (Section 13 of Standard Specification Item No. 410S, "Concrete Structures") to lower the concrete temperature; however, the Contractor shall furnish a mix design acceptable to the Engineer or designated representative for class of concrete specified. The addition of ice shall not exceed 50% of the total mix water weight.

403S.5 Measurement of Materials

Water shall be accurately metered. Fine and coarse aggregates, mineral filler, bulk cement and fly ash shall be weighed separately. Allowances shall be made in the water volume and aggregate weights during batching for moisture content of aggregates and admixtures. Volumetric and weight measuring devices shall be acceptable to the Engineer or designated representative. Measurement of materials in non-volumetric and volumetric mixers shall conform to Section 421.4.D of TxDOT Specification Item 421, "Hydraulic Cement Concrete".

Batch weighing of sacked cement is not required; however, bags, individually and entire shipments, may not vary by more than 3 percent from the specified weight of 94 pounds (42.6 kilograms) per bag. The average bag weight of a shipment shall be determined by weighing 50 bags taken at random.

403S.6 Mix Design

The Contractor shall furnish a mix design acceptable to the Engineer or designated representative for the class of concrete required in accordance with Table 5. The mix shall be designed by a qualified commercial laboratory and signed/sealed by a registered Professional Engineer, licensed in the state of Texas to conform with requirements contained herein, to ACI 211.1 or TxDOT Bulletin C-11 (and supplements thereto). The maximum water-to-cementitious material ratio identified in Table 5 for specific classes of concrete shall not be exceeded.

A higher-strength class of concrete with equal or lower water-to-cementitious-material ratio may be substituted for the specified class of concrete.

The mix design shall be over-designed in accordance with Table 5 in order to account for production variability and to ensure minimum compressive strength requirements are met.

Allowable mix design options are presented in Section 403S.8.

The Contractor shall perform, at the Contractor's expense, the work required to substantiate the design, including testing of strength specimens. Complete concrete design data shall be submitted to the Engineer or designated representative for approval. The mix design will be valid for a period of one (1) year provided that there are no changes to the component materials.

When there are changes in aggregates or in type, brand or source of cement, supplementary cementing material or chemical admixtures, the mix shall be evaluated as a new mix design. A change in vendor does not necessarily constitute a change in materials or source. When only the brand or source of cement is changed and there is a prior record of satisfactory performance of the cement with the ingredients, the submittal of new trial batches may be waived by the Engineer or designated representative.

At the end of one (1) year, a previously approved mix may be resubmitted for approval if it can be shown that no substantial change in the component materials has occurred and that test results confirming the adequacy of the mix designs have been acquired during the previous year. The resubmittal analysis must be reviewed, signed and sealed by a registered Professional Engineer, licensed in the state of Texas. This resubmittal shall include a

reanalysis of specific gravity, absorption, fineness modulus, sand equivalent, soundness, wear and unit weights of the aggregates. Provided that the fineness modulus did not deviate by more than 0.20 or that the re-proportioned total mixing water, aggregate and cement (or cement plus fly ash) are within 1, 2, and 3 percent, respectively, of pre-approved quantities, a one-year extension on the approval of the mix may be granted by the Engineer or designated representative. Updated cement, fly ash, and admixture certifications shall accompany the resubmittal.

Approved admixtures that are included in the prequalified concrete admixtures list maintained by TxDot's Construction Division may be used with all classes of concrete at the option of the Contractor provided that specific requirements of the governing concrete structure specification are met. Water reducing and retarding agents shall be required for hot weather, large mass, and continuous slab placements. Air entraining agents may be used in all mixes but must be used in the classes indicated on Table 5. Unless approved by the Engineer or designated representative, mix designs shall not exceed air contents for extreme exposure conditions as recommended by ACI 211.1 for the various aggregate grades.

403S.7 Consistency and Quality of Concrete

Concrete shall be workable, cohesive, possess satisfactory finishing qualities and of stiffest consistency that can be placed and vibrated into a homogeneous mass within slump requirements specified in Table 4 without the development of segregation or honeycombing. No concrete will be permitted with a slump in excess of the maximums shown unless water-reducing admixtures have been previously approved. Concrete that exceeds the maximum acceptable placement slump at time of delivery will be rejected. Slump values shall be conducted in accordance with TXDOT Test Method TEX-415-A.

Consistency and quality of concrete should allow efficient placement and completion of finishing operations before initial set. Re-tempering (i.e. addition of water and reworking concrete after initial set) shall not be allowed. When field conditions are such that additional moisture is needed for final concrete surface finishing operation, the required water shall be applied to surface by fog spray only and shall be held to a minimum. Excessive bleeding shall be avoided and in no case will it be permissible to expedite finishing and drying by sprinkling the surface with cement powder.

	Slump¹, inches (mm)	
Type of Construction	Maximum	Minimum
Cased Drilled Shafts	4 (100)	3 (75)
Reinforced Foundation Caissons and Footings	3 (75)	1 (25)
Reinforced Footings and Substructure Walls	3 (75)	1 (25)
Uncased Drilled Shafts	6 (150)	5 (125)
Thin-walled Sections; 9 inches (225 mm) or less	6½ (165)	4 (100)
Prestressed Concrete Members ¹	6½ (165)	4 (100)
Precast Drainage Structures	6 (150)	4 (100)
Wall Sections over 9 inches (225 mm)	5 (125)	3 (75)
Reinforced Building Slabs, Beams, Columns and Walls	4 (100)	1 (25)
Bridge Decks	4 (100)	2 (50)
Pavements, Fixed-form	6½ (165)	4 (100)
Pavements, Slip-form	3 (75)	1½ (37.5)
Sidewalks, Driveways and Slabs on Ground	4 (100)	2 (50)
Curb & Gutter, Hand-vibrated	3 (75)	1 (25)
Curb & Gutter, Hand-tamped or spaded	4 (100)	2 (50)
Curb & Gutter, Slip-form/extrusion machine	2 (50)	½ (12.5)

Heavy Mass Construction	2 (50)	1 (25)
High Strength Concrete	4 (100)	3 (75)
Riprap and Other Miscellaneous Concrete	6 (150)	1 (25)
Under Water or Seal Concrete	8½ (213)	6 (150)

1. Slump values when a high range water reducer (HRWR) is not used.
2. When a high range water reducer (HRWR) is used, maximum acceptable placement slump will be 9 in (225 mm).

During progress of the work, the Engineer or designated representative shall cast test cylinders as a check on compressive strength of concrete actually placed. The Engineer or designated representative may also perform slump tests, entrained air tests and temperature checks to ensure compliance with specifications.

Proportioning of all material components shall be checked prior to discharging. Excluding mortar material for pre-coating of the mixer drum [see section 403S.8.B] and adjustment for moisture content of admixtures and aggregates, material components shall fall within the range of + 1% for water, + 2% for aggregates, + 3% for cement, +2% for fly ash and within manufacturer recommended dosage rates for admixtures except that air entrainment shall be within + 1½ percentage points of the mix design requirements.

Unless otherwise specified or indicated on the drawings, concrete mix temperature shall not exceed 90°F (32°C) except in mixes with high range water reducers where a maximum mix temperature of 100°F (38°C) will be allowed. Cooling an otherwise acceptable mix by addition of water or ice during agitation will not be allowed.

Test cylinders will be required for small placements such as manholes, inlets, culverts, wing walls, etc. The Engineer or designated representative may vary the number of tests to a minimum of 1 for each 25 cubic yards (1 for each 19 cubic meters) placed over a several day period.

Test cylinders shall be required for each monolithic placement of bridge decks or superstructures, top slabs of direct traffic culverts, cased drilled shafts, structural beams and as otherwise directed by Engineer or designated representative for design strength confirmation or early form removal. Test cylinders made for early form removal or for consideration of use of structure will be at Contractor's expense, except when required by Engineer or designated representative.

A strength test shall be defined as the average breaking strength of 2 cylinders. A minimum of four test cylinders shall be prepared; two each to be tested at 7 and 28 days. Specimens will be tested conforming to TXDOT Test Method TEX-418-A. If required strength or consistency of class of concrete being produced cannot be secured with minimum cementitious material specified or without exceeding maximum water/cementitious material ratio, Contractor will be required to furnish different aggregates, use a water reducing agent, an air entraining agent or increase the cement content in order to provide concrete meeting these specifications.

Slump tests will be performed in accordance with TxDoT Test Method Tex-415-A. Entrained air tests will be performed in accordance with TxDoT Test Method Tex-416-A.

Test specimens shall be cured using the same methods and under the same conditions as the concrete represented. Design strength cylinders shall be cured conforming to TXDOT Bulletin C-11 (and supplements thereto).

When control of concrete quality is by 28-day compressive tests, job control testing will be by 7-day compressive strength tests. The minimum strength requirement for seven (7) day test will be 70 percent of the specified minimum 28-day compressive strength. If the required 7-day strength is not secured with the quantity of cement specified in Table 4, changes in the mix design shall be made and resubmitted for approval. For an occasional failure of the seven-day compressive test, the concrete may be tested at 28 days for final evaluation.

Table 5: Classes of Concrete

Class	Cement Skes Per CY	Minimum Strength, psi (MPa)		Maximum W/C Ratio ¹	Coarse Aggr. Grade ^{2,3,4}	Air Entrain.
		28 Days	7 Days			
A	5.0 (280 kg/m ³)	3000 (20.6)	2100 (14.5)	0.6	1,2,3,4,8	Yes
B	4.0 (225 kg/m ³)	2000 (13.8)	1400 (9.7)	0.6	2,3,4,5,6,7	No
C ⁵	6.0 (335 kg/m ³)	3600(24.8)	2520 (17.4)	0.45	1,2,3,4,5,6	Yes
D	4.5 (252 kg/m ³)	2500 (17.2)	1750 (12.1)	0.6	2,3,4,5,6,7	No
H ⁵	6.0 (335 kg/m ³)	As indicated	As Indicated	0.45	3,4,5,6	Yes
I	5.5 (308 kg/m ³)	3500 (24.1)	2450 (16.9)	0.45	2,3,4,5	Yes
J	2.0 (112 kg/m ³)	800 (5.5)	560 (3.9)	N/A	2,3,4,5	No
S ⁵	6.0 (335 kg/m ³)	4000 (27.6)	2800 (19.3)	0.45	2,3,4,5	Yes

Notes:

1. Maximum water-cement or water-cementitious ratio by weight
2. Unless otherwise allowed, Grade 1 coarse aggregate shall only be used in massive foundations with 4-in (100-mm) minimum clear spacing between reinforcing steel bars.
3. Grade 1 coarse aggregate grading shall not be used in drilled shafts.
4. Unless otherwise allowed, Grade 8 coarse aggregate shall be used in extruded curbs.
5. Structural concrete classes.
6. When Type II cement is used in Class C, S or A concrete, the 7-day compressive strength requirement will be 2310 psi (15.9 MPa) for Class C, 2570 psi (17.7 MPa) for Class S and 1925 psi (13.3 MPa) for Class A minimum.

Table 6: Over Design Required to Meet Compressive Strength Requirements ¹					
Number Of Tests ^{2,3}	Standard Deviation, psi (MPa)				
	300 (2.06)	400 (2.75)	500 (3.44)	600 (4.13)	700 (4.82)
15	470 (3.24)	620 (4.27)	850 (5.85)	1,120 (7.71)	1,390 (9.57)
20	430 (2.96)	580 (3.99)	760 (5.23)	1,010 (6.95)	1,260 (8.67)
30 or more	400 (2.75)	530 (3.65)	670 (4.61)	900 (6.20)	1,130 (7.78)

Notes:

1. When designing the mix, add the tabulated amounts to the minimum design strength in Table 5. Maximum water-cement or water-cementitious ratio by weight
2. Number of tests of a concrete mixture used to estimate the standard deviation of a concrete production facility. Test of another mix within 1,000 psi (6.88 MPa) of the specified strength may be used.
3. If less than 15 prior tests are available, the overdesign should be 1,000 psi (6.88 MPa) for specified strength less than 3,000 psi (20.65 MPa), 1,200 psi (8.26 MPa) for specified strengths from 3,000 to 5,000 psi (20.65 to 34.42 MPa) and 1,400 psi (9.64 MPa) for specified strengths greater than 5,000 psi (34.42 MPa).

Table 7: Expected Usage of Concrete Classes	
Class	General Usage
A	Inlets, manholes, curb, gutter, curb & gutter, concrete retards, sidewalks, driveways, backup walls and anchors
B	Riprap, small roadside signs and anchors

C ⁵	Drilled shafts, bridge substructure, bridge railing, culverts except top slab of direct traffic culverts, headwalls, wing walls, approach slabs, and cast-in-place concrete traffic barrier
D	Riprap
H ⁵	Prestressed concrete beams, boxes, piling and precast concrete traffic barrier
J	Utility trench repair
S ⁵	Bridge slabs and top slabs of direct traffic culverts

Table 8: Air Entrainment ¹		
Nominal Maximum Aggregate Size In (mm)	% Air Entrainment	
	Moderate Exposure	Severe Exposure
¾(9.5)- Grades 7 & 8	6	7½
½ (12.5)- Grades 6	5½	7
¾ (19)- Grades 5	5	6
1 (25)- Grades 4	4½	6
1½ (37.5)- Grades 2 & 3	4½	5½
2 (50)- Grades 2	4	5

1. For specified concrete strengths above 5,000 psi (34.42 MPa) a reduction of 1 percentage point is allowed.

403S.8 Mix Design Options

For the structural concretes identified in Table 5 (Classes C, H and S) and any other class of concrete designed using more than 520 lbs. of cementitious material per cubic yard (310 kgs per cubic meter), one of the mix design options presented below shall be used.

For the non-structural concretes identified in Table 5 (Classes A, B, D and I) and any other class of concrete designed using less than 520 lbs. of cementitious material per cubic yard (310 kgs per cubic meter), one of the mix design options presented below will be used, except that Class C fly ash may be used instead of Class F fly ash for Options 1, 3 and 4 unless a sulfate-resistant concrete is required.

- A. Option 1: Twenty (20) to thirty-five (35) percent of the cement may be replaced with Class F fly ash.
- B. Option 2: Thirty-five (35) to fifty (50) percent of the cement may be replaced with ground granulated blast-furnace slag.
- C. Option 3: Thirty-five (35) to fifty (50) percent of the cement may be replaced with a combination of Class F fly ash, ground granulated blast-furnace slag or silica fume. The combination may not include more than thirty-five (35) percent fly ash and no more than ten (10) percent silica fume.
- D. Option 4: Type IP or Type IS will be used and up to ten (10) percent of the cement may be replaced with Class F fly ash, ground granulated blast-furnace slag or silica fume.
- E. Option 5: Thirty-five (35) to fifty (50) percent of the cement may be replaced with a combination of Class C fly ash and at least six (6) percent of silica fume, ultra fine fly ash or metakaolin. The combination may not include more than thirty-five (35) percent fly ash and no more than ten (10) percent silica fume.
- F. Option 6: A lithium nitrate admixture will be added at a minimum dosage of 0.55 gal. of thirty (30) percent lithium nitrate solution per pound of alkalis present in the hydraulic cement.
- G. Option 7: When hydraulic cement only is used in the design, the total alkali contribution from the cement in the concrete does not exceed 4.0 lbs. per cubic yard, when calculated as follows:

alkali (lbs. per CY) = .01 (lbs cement/CY) (% Na₂O equivalent in cement)

where (% Na₂O equivalent in cement) is assumed to be the maximum cement alkali content reported on the cement mill certificate.

- H. Option 8: When there are deviations from Options 1 through 7, the following shall be performed:
1. Conduct tests on both coarse and fine aggregate separately in accordance with ASTM C-1260, using 440 g of the proposed cementitious in the same proportions of hydraulic cement to supplementary cementing material to be used in the mix.
 2. Prior to use of the mix, a certified test report signed and sealed by a Professional Engineer, licensed in the state of Texas shall be submitted that demonstrates that ASTM C 1260 test results for each aggregate do not exceed 0.10 percent expansion.

403S.9 Mixing and Mixing Equipment

All equipment, tools and machinery used for hauling materials and performing any part of the work shall be maintained in such condition to insure completion of the work without excessive delays for repairs and replacement. Mixing shall be done in a mixer of approved type and size that will produce uniform distribution of material throughout the mass and shall be capable of producing concrete meeting requirements of ASTM C 94, Ready-mixed Concrete and these specifications. Mixing equipment shall be capable of producing sufficient concrete to provide required quantities. Entire contents of the drum shall be discharged before any materials are placed therein for a succeeding batch. Improperly mixed concrete shall not be placed in a structure. For all mixers an adequate water supply and an accurate method of measuring the water shall be provided.

The mixer may be batched by either volumetric or weight sensing equipment and shall be equipped with a suitable timing device that will lock the discharging mechanism and signal when specified time of mixing has elapsed.

A. Proportioning and Mixing Equipment

For all miscellaneous concrete placements, a mobile, continuous, volumetric mixer or a volumetric or weight batch mixer of the rotating paddle type may be used.

When approved by Engineer or designated representative in writing or when specified for use in other items, these mixers may be used for other types of concrete construction, including structural concrete, if the number of mixers furnished will supply the amount of concrete required for the particular operation in question.

These mixers shall be designed to receive all the concrete ingredients, including admixtures, required by the mix design in a continuous uniform rate and mix them to the required consistency before discharging.

For continuous volumetric mixers, the materials delivered during a revolution of the driving mechanism or in a selected interval, will be considered a batch and the proportion of each ingredient will be calculated in the same manner as for a batch type plant.

Mixing time shall conform to recommendations of manufacturer of mixer unless otherwise directed by Engineer or designated representative.

B. Ready-mixed Concrete

Use of ready-mixed concrete will be permitted provided the batching plant and mixer trucks meet quality requirements specified herein. When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the mixer drum. Ready-mixed concrete, batching plant and mixer truck operation shall include the following:

1. A ticket system will be used that includes a copy for the Inspector. Ticket will have machine stamped time/date of concrete batch, a mix design designation, weight of cement, fly ash, sand and aggregates;

exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on ticket may be cause for rejection of concrete.

2. Sufficient trucks will be available to support continuous placements. The Contractor will satisfy the Engineer or designated representative that adequate standby trucks are available to support monolithic concrete placement requirements.
3. A portion of mixing water required by the mix design to produce the specified slump may be withheld and added at the job site, but only with permission of the Engineer or designated representative and under the Inspector's observation. When water is added under these conditions, the concrete batch will be thoroughly mixed before any slump or strength samples are taken. Additional cement shall not be added at the job site to otherwise unacceptable mixes.
4. A metal plate(s) shall be attached in a prominent place on each truck mixer plainly showing the various uses for which it was designed. The data shall include the drum's speed of rotation for mixing and for agitating and the capacity for complete mixing and/or agitating only. A copy of the manufacturer's design, showing dimensions of blades, shall be available for inspection at the plant at all times. Accumulations of hardened concrete shall be removed to the satisfaction of the Engineer or designated representative.
5. The loading of the transit mixers shall not exceed capacity as shown on the manufacturer's plate attached to the mixer or 63 percent of the drum volume, whichever is the lesser volume. The loading of transit mixers to the extent of causing spill-out en route to delivery will not be acceptable. Consistent spillage will be cause for disqualification of a supplier.
6. Excess concrete remaining in the drum after delivery and wash water after delivery shall not be dumped on the project site unless approval of the dump location is first secured from the Engineer or designated representative.

C. Volumetric Batching

Use of volumetric batched concrete will be permitted provided the batching and continuous mixing operations conform to ASTM C 685, "Concrete Made By Volumetric Batching and Continuous Mixing". This type concrete shall be made from materials continuously batched by volume, mixed in a continuous mixer and delivered to the site in a freshly mixed and unhardened state. Tests and criteria for batching accuracy and mixing efficiency shall be as specified in ASTM C 685.

1. A ticket system will be used that includes a copy for the Inspector. The ticket will have machine stamped time/date of concrete batch, a mix design designation, weight of cement, fly ash, sand and aggregates; exact nomenclature and written quantities of admixtures and water. Any item missing or incomplete on ticket may be cause for rejection of concrete.
2. Each batching or mixing unit, or both, shall carry in a prominent place a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, discharge speed and the weight-calibrated constant of the machine in terms of a revolution counter or other output indicator. The mixer shall produce a thoroughly mixed and uniform concrete.
3. The batcher-mixer unit shall contain in separate compartments all the necessary ingredients needed for the manufacture of concrete. The unit shall be equipped with calibrated proportioning devices to vary the mix proportions and it shall produce concrete as required by the Work and ASTM C 685.

D. Truck-mixed Concrete

The concrete shall be mixed in a truck mixer from 70 to 100 revolutions at the mixing speed designated by the manufacturer that will produce a uniform concrete mix. The concrete shall be delivered to the project in a thoroughly mixed and uniform mass and shall be discharged with a satisfactory degree of uniformity. Additional mixing at the job site, at the mixing speed designated by the manufacturer, may be allowed by the

Engineer or designated representative as long as the concrete is discharged before the drum has revolved a total of 300 revolutions after the introduction of the mixing water to the cement and the aggregates.

Re-tempering or adding concrete chemical admixtures is only permitted at the job site when concrete is delivered in a truck mixer. Water shall not be added after introduction of mixing water at the batch plant except on arrival at the job site with approval of the Engineer or designated representative, in order to adjust the slump of the concrete. When this water is added, the mix design water-cementitious-material ratio shall not be exceeded. The drum or blades shall be turned at least 30 additional revolutions at mixing speed to ensure thorough and uniform mixing of the concrete. Water or chemical admixtures shall not be added to the batch after any concrete has been discharged.

When the concrete contains silica fume, mixing times and batching operations shall be adjusted as necessary to ensure that the material is completely and uniformly dispersed in the mix. The dispersion of the silica fume within the mix shall be verified in trial batches.

E. Hand-mixed Concrete

Hand mixing of concrete may be permitted for small placements or in case of an emergency and then only on authorization of the Engineer or designated representative. Hand-mixed batches shall not exceed a 4 cubic foot (0.113 cubic meters) batch in volume. Material volume ratios shall not be leaner than 1 part cement, 2 parts large aggregate, 1 part fine aggregate and enough water to produce a consistent mix with a slump not to exceed 4 inches (100 mm). Admixtures shall not be used unless specifically approved by the Engineer or designated representative.

403S.10 Excavation, Placing of Concrete, Finishing, Curing and Backfill

Excavation, placing of concrete, finishing, curing and backfill shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill", Standard Specification Item No. 410S, "Concrete Structures" and Standard Specification Item No. 411S, "Surface Finishes for Concrete".

403S.11 Measurement

Where measurement of concrete for a structure is not provided by another governing pay item, measurement shall be made under this specification in accordance with the following.

The quantities of concrete of the various classifications which constitute the completed and accepted structure or structures in place will be measured by the cubic yard (cubic meters: 1 cubic meter is equal to 1.308 cubic yards), each, square yard (square meter: 1 square yard equals 0.836 square meters) or linear foot as indicated in the Contract Documents. Measurement will be as follows:

A. General

1. Measurement based on dimensions shall be for the completed structure as measured in place. However, field-measured dimensions shall not exceed those indicated on the drawings or as may have been directed by the Engineer or designated representative in writing.
2. No deductions shall be made for chamfers less than 2 inches (50 mm) in depth, embedded portions of structural steel, reinforcing steel, nuts, bolts, conduits less than 5 inches (125 mm) in diameter, pre/post tensioning tendons, keys, water stops, weep holes and expansion joints 2 inches (50 mm) or less in width.
3. No measurement shall be made for concrete keys between adjoining beams or prestressed concrete planks.

4. No measurement shall be made for fill concrete between the ends or adjoining prestressed concrete planks/box beams at bent caps or between the ends of prestressed concrete planks/box beams and abutment end walls.
 5. No measurement shall be made for inlet and junction box invert concrete.
 6. No measurement shall be made for any additional concrete required above the normal slab thickness for camber or crown.
- B. Plan Quantity. For those items measured for plan quantity payment, adequate calculations have been made. If no adjustment is required by Article 403S.11, additional measurements or calculations will not be required or made.
- C. Measured in Place. For those items not measured for Plan Quantity payment, measurement will be made in place, subject to the requirements of Article 403S.10.A.1 above.

403S.12 Payment

The work performed and materials furnished as prescribed by this item and measured in accordance with the applicable provisions of "Measurement" above will be paid for as follows.

The quantity to be paid for will be that quantity indicated in the contract documents and/or shown on the drawings, regardless of errors in calculations, except as may be modified by the following.

Plan Quantities will be adjusted:

- A. When a complete structure element has been erroneously included or omitted from the drawings, the quantity shown on the drawings for that element will be added to or deducted from the plan quantity and included for payment. A complete structure element will be the smallest portion of a total structure for which a quantity is included on the drawings. Quantities revised in this manner will not be subject to the provisions of the "General Conditions", Article 11.
- B. When the plan quantity for a complete structure element is in error by 5 percent or more, a recalculation will be made and the corrected quantity included for payment. Quantities revised in this manner will not be subject to the provisions of the "General Conditions", Article 11.
- C. When quantities are revised by a change in design, the "plan quantity" will be increased or decreased by the amount involved in the design change. Quantities revised in this manner will be subject to the provisions of the "General Conditions", Article 11.

The party to the contract requesting the adjustment shall present to the other, a copy of the description and location, together with calculations of the quantity for the structure element involved. When this quantity is certified correct by the Engineer or designated representative, it will become the revised plan quantity.

Payment for increased or decreased costs due to a change in design on those items measured as "Cubic Yard", "Each", "Square Foot", "Square Yard" or "Linear Foot" will be determined by Change Order. Quantities revised in this manner will be subject to the provisions of the "General Conditions", Article 11.

The unit prices bid for the various classes of concrete shown shall include full compensation for furnishing, hauling, and mixing all concrete material; placing, finishing and curing all concrete; all grouting, pointing and finishing; furnishing and placing drains; furnishing and placing metal flashing strips; furnishing and placing expansion joint material required by this item; and for all forms and false work, labor, tools, equipment and incidentals necessary to complete the work.

Pay Item No. 403S-CY:	(Structure or Structural Component)	Per Cubic Yard.
Pay Item No. 403S-EA:	(Structure or Structural Component)	Per Each.
Pay Item No. 403S-SY:	(Structure or Structural Component)	Per Square Yard.

Pay Item No. 403S-LF:	(Structure or Structural Component)	Per Lineal Foot.
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End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Standard Specification Item 403S, "Concrete For Structures"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 401S	Structural Excavation and Backfill
Item No. 410S	Concrete Structures
Item No. 411S	Surface Finishes for Concrete
<u>Texas Department of Transportation: Departmental Material Specifications</u>	
<u>Designation</u>	<u>Description</u>
DMS-4640	Chemical Admixtures for Concrete
<u>American Association of State Highway & Transportation Officials, AASHTO Standard Method of Test for</u>	
<u>Designation</u>	<u>Description</u>
Method T 26	Quality of Water to be Used in Concrete
<u>American Concrete Institute, ACI</u>	
<u>Designation</u>	<u>Description</u>
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
<u>American Society for Testing and Materials, ASTM</u>	
<u>Designation</u>	<u>Description</u>
ASTM C 94	Specification For Ready-Mixed Concrete
ASTM C 150	Specification For Portland Cement
ASTM C 685	Concrete Made By Volumetric Batching and Continuous Mixing
ASTM C-1260	Standard Test Method for Potential Alkali Reactivity of Aggregates
ASTM D-512	Test Methods for Chloride Ion in Water
ASTM D-516	Test Methods for Sulfate Ion in Water
ASTM D-4191	Test Method for Sodium in Water by Atomic Absorption
ASTM D-4192	Test Method for Potassium Water by Atomic Absorption
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
TEX-203-F	Sand Equivalent Test
TEX-401-A	Sieve Analysis of Fine and Coarse Aggregate
TEX-406-A	Mineral Finer than 75 µm (No. 200) Sieve in Mineral Aggregates (Decantation Test for Concrete Aggregates)
TEX-408-A	Organic Impurities in Fine Aggregate for Concrete
TEX-410-A	Abrasion of Coarse Aggregate Using The Los Angeles Machine
TEX-411-A	Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
TEX-413-A	Determination of Deleterious Materials in Mineral Aggregate
TEX-415-A	Slump of Portland Cement Concrete

TEX-416-A	Air Content of Freshly-Mixed Concrete by the Pressure Method
TEX-418-A	Compressive Strength of Cylindrical Concrete Specimens
TEX-612-J	Acid Insoluble Residue
<u>Texas Department of Transportation: Publications</u>	
<u>Designation</u>	<u>Description</u>
Bulletin C-11	Construction Bulletin
<u>Texas Department of Transportation: Departmental Material Specifications</u>	
<u>Designation</u>	<u>Description</u>
DMS-4610	Fly Ash
DMS-4620	Ground Granulated Blast-Furnace Slag
DMS-4630	Silica Fume
DMS-4635	Metakaolin

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item 403S, "Concrete For Structures"</u>	
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 360	Concrete Pavement
Item 420	Concrete Structures
Item 421	Hydraulic Cement Concrete
Item 427	Surface Finishes for Concrete
Item 431	Pneumatically Placed Concrete
Item 520	Weighing and Measuring Equipment
<u>Texas Department of Transportation: Departmental Material Specifications</u>	
<u>Designation</u>	<u>Description</u>
DMS-4650	Hydraulic Cement Concrete Curing Materials and Evaporation Retardants
DMS-6100	Epoxy and Adhesives
DMS 8900	Fly Ash

ITEM NO. 405S CONCRETE ADMIXTURES 11-13-07

405S.1 Description

This item shall govern material requirements of admixtures for Portland cement concrete.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

405S.2 Submittals

The submittal requirements of this specification item include:

- A. Type and manufacturer of any proposed admixture.
- B. Certification that proposed admixture meet the requirements of this specification, ASTM C260 and ASTM C494.
- C. For a specific mix design, a statement of compatibility of products shall be submitted when admixtures from multiple manufacturers are proposed.

405S.3 Materials

All admixture submittals must be approved by the Engineer or designated representative. No admixture shall be chloride-based or have chloride(s) added in the manufacturing process. Admixtures must be pretested by the Texas Department of Transportation (TXDOT) Materials and Tests Engineer and be included in the State's current approved admixture list. All admixtures must retain an approved status through the duration of a mix design's one-year approval period.

(1) Air Entraining Admixture:

An "Air Entraining Admixture" is defined as a material which, when added to a concrete mixture in the proper quantity, will entrain uniformly dispersed microscopic air bubbles in the concrete mix. The admixture shall meet the requirements of ASTM Designation: C 260 modified as follows:

- (a) The cement used in any series of test shall be either the cement proposed for the specific work or a "reference" Type I cement from one mill.
- (b) The air entraining admixture used in the reference concrete shall be Neutralized Vinsol Resin.

(2) Water-reducing Admixture:

A "Water-reducing Admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given consistency and required strength. This admixture shall conform to ASTM C 494, Type A.

(3) Accelerating Admixture:

An "Accelerating Admixture" is defined as an admixture that accelerates the setting time and the early strength development of concrete. This admixture shall conform to ASTM C 494, Type C. The accelerating admixture will contain no chlorides.

(4) Water-reducing, Retarding Admixture:

A "Water-reducing, Retarding Admixture" is defined as a material which, when added to a concrete mixture in the correct quantity, will reduce the quantity of mixing water required to produce concrete of a given consistency and retard the initial set of the concrete. This admixture shall conform to ASTM C 494, Type D.

(5) **High-range Water Reducing Admixtures:**

A "High-range Water Reducing Admixture", referred to as a superplasticizer, is defined as a synthetic polymer material which, when added to a low slump concrete mixture increases the slump without adversely affecting segregation, impermeability or durability of the mix. This admixture shall conform to ASTM C 494, Type F or G.

(6) **Fly Ash:**

Fly ash used in Portland cement concrete as a substitute for Portland cement or as a mineral filler shall comply with TXDOT Materials Specification D-9-8900 and be listed on TXDOT's current list of approved fly ash sources. Fly ash obtained from a source using a process fueled by hazardous waste (30 Texas Administrative Code, Section 335.1) shall be prohibited. This applies to any other specification concerning the use of fly ash. Contractor shall maintain a record of source for each batch. Supplier shall certify that no hazardous waste is used in the fuel mix or raw materials.

405S.4 Certification and Product Information

The Contractor shall submit the name of the admixture proposed and manufacturer's certification that the selected admixtures meet the requirements of this item and of ASTM C 260 and C 494 as applicable. Admixtures for a mix design shall be of the same brand. If more than one admixture is proposed in the concrete mix, a statement of compatibility of components shall accompany certification. Manufacturer's product literature shall specify when in the batching/mixing operation the admixture must be added.

The Engineer or designated representative may request additional information such as infrared spectrophotometry scan, solids content, pH value, etc., for further consideration. Any unreported changes in formulation discovered by any of the tests prescribed herein may be cause to permanently bar the manufacturer from furnishing admixtures for Owner's work.

405S.5 Construction Use of Admixtures

All admixtures used shall be liquid except high-range water reducers which may be a powder. Liquid admixtures shall be agitated as needed to prevent separation or sedimentation of solids; however, air agitation of Neutralized Vinsol Resin will not be allowed.

No admixture shall be dispensed on dry aggregates. Admixtures shall be dispensed at the batching site separately, but at the same time as the mixing water. Only high range water reducers may be introduced into the mix at the job site.

When other admixtures are used with fly ash, the amount of the other admixture to be used shall be based on the amount of Portland cement only and not the amount of Portland cement and fly ash.

When high-range water reducers are to be added at the job site, transit mixers shall be used. Admixture manufacturer literature shall indicate recommended mixing methods and time for the specific equipment and mix design used. The transit mix equipment shall not be loaded in excess of 63 percent of its rated capacity to ensure proper mixing of the admixture at the site. If during discharging of concrete a change in slump in excess of 30% is noted, the remaining concrete shall be rejected unless prior approval was given by the Engineer or designated representative to retemper a load with a second charge of admixture. Retempering with water shall not be allowed.

Accelerating admixtures will not be permitted in combination with Type II cement.

All mixes with air entrainment shall have a minimum relative durability factor of 80 in accordance with ASTM C 260. Dosage of air entrainment admixtures may be adjusted by the Contractor to stay within the specified tolerances for air entrainment of Standard Specification Item No. 403S, "Concrete for Structures".

405S.6 Measurement and Payment

The requirements of this specifications shall not be measured and paid for directly, but shall be included in the unit price bid for the item of construction in which this item is used.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Item No. 405S, "Concrete Admixtures"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures
<u>American Society for Testing and Materials, ASTM</u>	
<u>Designation</u>	<u>Description</u>
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C495	Chemical Admixtures for Concrete
<u>Texas Department of Transportation: Department Material Specification</u>	
<u>Designation</u>	<u>Description</u>
DMS-8900	Fly Ash

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item No. 405S, "Concrete Admixtures"</u>	
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 360	Concrete Pavement
Item 420	Concrete Structures
Item 421	Portland Cement Concrete
Item 427	Surface Finishes for Concrete
Item 431	Pneumatically Placed Concrete
Item 437	Concrete Admixtures
Item 520	Weighing and Measuring Equipment
Item 522	Portland Cement Concrete Plants
Item 524	Hydraulic Cement

ITEM NO. 406S REINFORCING STEEL 9-26-12

406S.1 Description

This item shall govern furnishing and placement of reinforcing steel, deformed and smooth, of the size and quantity indicated on the drawings and in accordance with these specifications.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

406S.2 Submittals

The submittal requirements of this specification item may include:

- A. Evidence that the steel reinforcement producer is included on the TxDOT list of approved producing mills
- B. Listing of the size, grade, type and quantity of reinforcing steel proposed for the project.
- C. If welding of reinforcing steel is proposed, evidence that carbon equivalent (C.E.) of the proposed steel is at least 0.55% with a report of chemical analysis showing the percentages of elements necessary to establish C.E.
- D. If epoxy coated steel is proposed, evidence that the steel reinforcement producer is included on the TxDOT list of approved epoxy coating applicators
- E. If epoxy coated steel is proposed, written certification that the epoxy-coated reinforcing steel meets the requirements of this Item with a copy of the manufacturer's control tests.
- F. When mechanical splices are proposed, the types of couplers proposed for use.

406S.3 Materials

A. Approved Mills

Prior to furnishing reinforcing steel, the producing mills must be included on the list of approved producing mills that is maintained by the Construction Division of the State of Texas Department of Transportation

B. Deformed Bars and Wire Reinforcement

Unless indicated otherwise on the drawings, Bar reinforcement shall be Grade 60 and deformed. Reinforcing steel must conform to one of the following:

ASTM A615/615M, Grades 40 or 60 (300 or 420)

ASTM A996/996M, Type A, Grades 40 or 60 (300 or 420)

ASTM A996/996M, Type R, Grade 60 (420), permitted in concrete pavement only (furnished as straight bars only without bends. Bend tests are not required)

ASTM A706/706M

In cases where the provisions of this item are in conflict with the provisions of the ASTM Designation to which reference is made, the provisions of this item shall govern.

The nominal size, area and weight (mass) of reinforcing steel bars covered by these specifications are as follows:

Bar Size Number ⅜ins (mm)	Nominal Diameter, inches (mm)	Nominal Area, Sq. ins. (mm ²)	Weight/Linear Foot Lbs. (kg)
2 (6)	0.250 (6.6)	0.05 (32)	0.167 (.075)
3 (10)	0.375 (9.5)	0.11 (71)	0.376 (.171)
4 (13)	0.500 (12.5)	0.20 (127)	0.668 (.303)
5 (16)	0.625 (15.5)	0.31 (198)	1.043 (.473)
6 (19)	0.750 (19.0)	0.44 (285)	1.502 (.681)
7 (22)	0.875 (22.0)	0.60 (388)	2.044 (.927)
8 (25)	1.000 (25.5)	0.79 (507)	2.670 (2.211)
9 (29)	1.128 (28.5)	1.00 (641)	3.400 (1.542)
10 (32)	1.270 (32.0)	1.27 (792)	4.303 (1.952)
11 (36)	1.410 (36.0)	1.56 (958)	5.313 (2.410)
14 (43)	1.693 (43.0)	2.25 (1552)	7.65 (3.470)
18 (57)	2.257 (57.5)	4.00 (2565)	13.60 (6.169)

Smooth, round bars shall be designated by size number through a No. 4. Smooth bars above No. 4 shall be designated by diameter in inches.

C. Smooth Bar and Spiral Reinforcement

Smooth bars and dowels for concrete pavement must have a minimum yield strength of 60 ksi (414 MPa) and meet ASTM A615/615M. Smooth bars that are greater in diameter than a No. 3 (10 mm) designation shall conform to ASTM A615 or meet the physical requirements of ASTM A36.

Spiral reinforcement shall be either smooth or deformed bars or wire of the minimum size or gauge indicated on the drawings. Bars for spiral reinforcement shall comply with ASTM A615 Grade 40(300), ASTM A996, Type A, Grade 40 (300); or ASTM A675, Grade 80(550), meeting dimensional requirements of ASTM A615. Smooth wire shall comply with ASTM A82, and deformed wire shall comply with ASTM A496.

D. Weldable Reinforcing Steel

Reinforcing steel to be welded must comply with ASTM A706 or have a carbon equivalent (C.E.) of at most 0.55%. A report of chemical analysis showing the percentages of elements necessary to establish C.E. is required for reinforcing steel that does not meet ASTM A706 to be structurally welded. No tack welding will be allowed. All welding shall conform to the requirements of AWS D1.1/D1.1M.

Carbon Equivalent (C.E.) shall be calculated as follows:

$$C.E. = \%C + 1.67*(\% Mn) + .025*(\% Cu) + .05*(\% Ni) + .01*(\%Cr) - .02*(\%Mo) - .1*(\%V)$$

Where C is carbon,

Mn is manganese

Cu is copper

Ni is nickel

Cr is chromium

Mo is molybdenum, and

V is vanadium.

The requirements above do not apply to the following miscellaneous welding applications:

Splicing reinforcing steel to extend bars in the bottom of a drilled shaft;

- Attaching chairs to the reinforcing steel cage of a drilled shaft;
- Armor joints and their supports;
- Screed rail and form hanger supports where permitted on steel units;
- Reinforcing steel to R-bars for lateral stability between prestressed beams, spirals, or bands of reinforcing bars in drilled shaft cages;
- Permanent bridge deck forms;
- Steel added in railing when slip-form construction is used; and
- Other similar miscellaneous members that have no load carrying capacity in the completed structure.

E. Welded Wire Fabric

Wire shall conform to the requirements of the Standard Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement, ASTM A 82 or A 496. Wire fabric, when used as reinforcement, shall conform to ASTM A 185 or A 497.

When wire is ordered by size numbers, the following relation between size number, diameter in inches and area shall apply unless otherwise indicated on the drawings:

Size, W Number 1/100 in ² (mm ²)	Nominal Diameter inch (mm)	Nominal Area, sq. inches (mm ²)
31 (200)	0.628 (16.0)	0.310 (200)
30 (194)	0.618 (15.7)	0.300 (194)
28 (181)	0.597 (15.2)	0.280 (181)
26 (168)	0.575 (14.6)	0.260 (168)
24 (155)	0.553 (14.0)	0.240 (155)
22 (142)	0.529 (13.4)	0.220 (142)
20 (129)	0.505 (12.8)	0.200 (129)
18 (116)	0.479 (12.2)	0.180 (116)
16 (103)	0.451 (11.5)	0.160 (103)
14 (90)	0.422 (10.7)	0.140 (90)
12 (77)	0.391 (9.9)	0.120 (77)
10 (65)	0.357 (9.1)	0.100 (65)
8 (52)	0.319 (8.1)	0.080 (52)
7 (45)	0.299 (7.6)	0.070 (45)
6 (39)	0.276 (7.0)	0.060 (39)
5.5 (35)	0.265 (6.7)	0.055 (35)
5 (32)	0.252 (6.4)	0.050 (32)
4.5 (29)	0.239 (6.1)	0.045 (29)
4 (26)	0.226 (5.7)	0.040 (26)
3.5 (23)	0.211 (5.4)	0.035 (23)
3 (19)	0.195 (5.0)	0.030 (19)
2.5 (16)	0.178 (4.5)	0.025 (16)
2 (13)	0.160 (4.1)	0.020 (13)
1.5 (9)	0.138 (3.5)	0.015 (9.7)
1.2 (8)	0.124 (3.1)	0.012 (7.7)
1 (6)	0.113 (2.9)	0.010 (6.5)
0.5 (3)	0.080 (2.0)	0.005 (3.2)

Where deformed wire is required, the size number shall be preceded by D and for smooth wire the prefix W shall be shown.

Welded wire fabric shall be designated as follows: 6 x 12 - W16 x W8, which indicates a 6 in. (150 mm) longitudinal wire spacing and 12-in (300 mm) transverse wire spacing with smooth No. 16 (103) wire longitudinally and smooth no. 8 (52) wire transversely.

F. Epoxy Coating

Epoxy coating shall be required as indicated on the drawings. Prior to furnishing epoxy-coated reinforcing steel, the epoxy applicator must be included on the list of approved applicators that is maintained by the Construction Division of the State of Texas Department of Transportation.

The reinforcing steel shall be epoxy coated in accordance with the following.

Epoxy Coating Requirements for Reinforcing Steel

Material	Specification
Bar	ASTM A775 or A934
Wire or Fabric	ASTM A884 Class A or B
Mechanical Coupler	As indicated on the drawings
Hardware	As indicated on the drawings

The epoxy coating material and coating repair material shall comply with TxDOT's DMS-8130, "Epoxy Powder Coating for Reinforcing Steel". The applicator shall not patch more than ¼ inch total length in any foot (20 mm total length in any meter) at the applicator's plant.

The epoxy-coated reinforcing steel shall be sampled and tested in accordance with TxDOT Test Method Tex-739-I, "Sampling and Testing Epoxy Coated Reinforcing Steel".

The identification of all reinforcing steel shall be maintained throughout the epoxy coating and fabrication and until delivery to the project site.

Written certification that the epoxy-coated reinforcing steel meets the requirements of this Item shall be provided along with a copy of the manufacturer's control tests.

G. Mechanical Couplers

When mechanical splices in reinforcing steel bars are indicated on the drawings, the following types of couplers may be used:

Sleeve-filler

Sleeve-threaded

Sleeve-swaged, or

Sleeve-wedge.

H. Chairs and Supports

Chairs and Supports shall be steel, precast mortar or concrete blocks cast in molds meeting the approval of the Engineer or designated representative of sufficient strength to position the reinforcement as indicated on the drawings when supporting the dead load of the reinforcement, the weight of the workers placing concrete and the weight of the concrete bearing on the steel. Chairs shall be plastic coated when indicated on the drawings.

Chair Types and Applicable Uses	
Structural or Architectural Elements (columns, beams, walls, slabs) exposed to weather, not subjected to sand blasting, water blasting or grinding.	Galvanized steel or steel chairs with plastic coated feet.
Structural or Architectural Elements exposed to weather and subject to sand blasting, water blasting or grinding.	Stainless steel chairs.
Structural or Architectural Elements not exposed to weather or corrosive conditions.	Uncoated steel chairs
Slabs and grade beams cast on grade.	Steel chairs with a base with 9 inch ² (58 cm ²) minimum area or sufficient area to prevent the chair from sinking into fill or subgrade. Precast mortar or concrete blocks meeting the requirements of this item may be used.

406S.4 Bending

The reinforcement shall be bent cold, true to the shapes indicated on the drawings. Bending shall preferably be done in the shop. Irregularities in bending shall be cause for rejection. Improperly fabricated, damaged or broken bars shall be replaced at no additional expense to the City. Damaged or broken bars embedded in a previous concrete placement shall be repaired using a method approved by the Engineer or designated representative.

Unless otherwise indicated on the drawings, the inside diameter of bar bends, in terms of the nominal bar diameter (d), shall be as follows:

Bends of 90 degrees and greater in stirrups, ties and other secondary bars that enclose another bar in the bend.

Bar Number in inches (mm)	Diameter
3, 4, 5 (10, 13, 16)	4d
6, 7, 8	6d

All bends in main bars and in secondary bars not covered above.

Bar Number in inches (mm)	Diameter
3 thru 8 (10 thru 25)	6d
9, 10, 11 (29, 32, 36)	8d
14, 18 (43, 57)	10d

406S.5 Tolerances

Fabricating tolerances for bars shall not be greater than shown on Standard (Detail) 406S-1.

406S.6 Storing

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, paint, grease, oil or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel indicated on the drawings.

406S.7 Splices

Splicing of bars, except when indicated on the drawings or specified herein, will not be permitted without written approval of the Engineer or designated representative. No substitution of bars will be allowed without the approval of the Engineer or designated representative. Any splicing of substituted bars shall conform to the requirements in the Table below.

Splices not indicated on the drawings will be permitted in slabs not more than 15 inches (380 mm) in thickness, columns, walls and parapets.

Splices will not be permitted in bars 30 feet (9.1 meters) or less in plan length unless otherwise approved. For bars exceeding 30 feet (9.1 meters) in plan length, the distance center to center of splices shall not be less than 30 feet (9.1 meters) minus 1 splice length, with no more than 1 individual bar length less than 10 feet (3 meters). Splices not indicated on the drawings, but permitted hereby, shall conform to the Table below. The specified concrete cover shall be maintained at such splices and the bars placed in contact and securely tied together.

Minimum Lap Requirements		
Bar Number in inches (mm)	Uncoated Lap Length	Coated Lap Length
3 (10)	1 foot 4 inches (0.4 meters)	2 foot 0 inches (0.610 meters)
4 (13)	1 foot 9 inches (0.533 meters)	2 foot 8 inches (0.813 meters)
5 (16)	2 foot 2 inches (0.660 meters)	3 feet 3 inches (0.991 meters)
6 (19)	2 foot 7 inches (0.787 meters)	3 feet 11 inches (1.194 meters)
7 (22)	3 feet 5 inches (1.041 meters)	5 feet 2 inches (1.575 meters)
No. 8 (25)	4 feet 6 inches (1.372 meters)	6 feet 9 inches (2.057 meters)
No. 9 (29)	5 feet 8 inches (1.727 meters)	8 feet 6 inches (2.591 meters)
No. 10 (32)	7 feet 3 inches (2.210 meters)	10 feet 11 inches (3.327 meters)
No. 11 (36)	8 feet 11 inches (2.718 meters)	13 feet 5 inches (4.089 meters)

Spiral steel shall be lapped a minimum of 1 turn. Bar No. 14 and No. 18 may not be lapped.

Welded wire fabric shall be spliced using a lap length that includes an overlap of at least 2 cross wires plus 2 inches (50 mm) on each sheet or roll.

Splices using bars that develop equivalent strength and are lapped in accordance with the table above are permitted.

Welding of reinforcing bars may be used only where indicated on the drawings or as permitted herein. All welding operations, processes, equipment, materials, quality of work and inspection shall conform to the requirements indicated on the drawings. All splices shall be of such dimension and character as to develop the full strength of the bar being spliced.

End preparation for butt-welding reinforcing bars shall be done in the field, except Bar No. 6 and larger shall be done in the shop. Delivered bars shall be of sufficient length to permit this practice.

For box culvert extensions with less than 1 foot (0.3 meters) of fill, the existing longitudinal bars shall have a lap with the new bars as shown in the table above. For box culvert extensions with more than 1 foot (0.3 meters) of fill, a minimum lap of 12 inches (300 mm) will be required.

Unless otherwise indicated on the drawings, dowel bars transferring tensile stresses shall have a minimum embedment equal to the minimum lap requirements shown in the table above. Shear transfer dowels shall have a minimum embedment of 12 inches (300 mm).

406S.8 Placement

Reinforcement shall be placed as near as possible in the position indicated on the drawings. Unless otherwise indicated on the drawings, dimensions shown for reinforcement are to the centers of the bars. In the plane of the steel parallel to the nearest surface of concrete, bars shall not vary from plan placement by more than 1/12 of the spacing between bars. In the plane of the steel perpendicular to the nearest surface of concrete, bars shall not vary from plan placement by more than ¼ inch (6 mm). Cover of concrete to the nearest surface of steel shall be as follows:

	Minimum Cover, Inches (mm)
(a) Concrete cast against and permanently exposed to earth	3 (76 mm)
(b) Concrete exposed to earth or weather:	
Bar No. 6 (19) through No. 18 bars (57)	2 (51 mm)
Bar No. 5 (16), W31 (W200) or D31 (D200) wire and smaller	1½ (38 mm)
(c) Concrete not exposed to weather or in contact with ground:	
Slabs, walls, joists:	
Bar No. 14 (43) and 18 (57)	1½ (38mm)
Bar No. 11 (36) and smaller	1 (25 mm)
Beams, columns:	
Primary reinforcement, ties, stirrups, spirals	1 ½ (38 mm)
Shells, folded plate members:	
Bar No. 6 (19) and larger	1 (25 mm)
Bar No. 5 (16), W31 (W200) or D31 (D200) wire, and smaller	1 (25 mm)

Vertical stirrups shall always pass around the main tension members and be attached securely thereto.

The reinforcing steel shall be located accurately in the forms and held firmly in place before and during concrete placement by means of bar supports that are adequate in strength and number to prevent displacement and to keep the steel at the required distance from the form surface. Bars shall be supported by means of approved galvanized metal spacers, metal spacers with plastic coated tips, stainless steel spacers, plastic spacers or approved precast mortar or concrete blocks when supports are in contact with removable or stay-in-place forms. Bright basic bar supports shall be used to support reinforcing steel placed in slab overlays on concrete panels or on existing concrete slabs. Bar supports in contact with soil or subgrade shall be approved.

For bar supports with plastic tips, the plastic protection must be at least 3/32 in. (2.4 mm) thick and extend upward on the wire to a point at least ½ in. (12.5 mm) above the formwork.

For approval of plastic spacers on a project, representative samples of the plastic shall show no visible indications of deterioration after immersion in a 5 percent solution of sodium hydroxide for 120 hours.

All accessories such as tie wires, bar chairs, supports, or clips used with epoxy-coated reinforcement shall be of steel, fully coated with epoxy or plastic. When approved by the Engineer or designated representative, plastic supports may also be used with epoxy-coated reinforcement.

All reinforcing steel shall be tied at all intersections, except that where spacing is less than 1 foot (300 mm) in each direction, alternate intersections only need be tied. For reinforcing steel cages for other structural members, the steel shall be tied at enough intersections to provide a rigid cage of steel. Mats of wire fabric shall overlap each other 1 full space as a minimum to maintain a uniform strength and shall be tied at the ends and edges.

Where prefabricated deformed wire mats are specified or if the Contractor requests, welded wire fabric may be substituted for a comparable area of steel reinforcing bar plan, subject to the approval of the Engineer or designated representative.

Mortar or concrete blocks shall be cast to uniform dimensions with adequate bearing area. A suitable tie wire shall be provided in each block, to be used for anchoring to the steel. Except in unusual cases and when specifically authorized by the Engineer, the size of the surface to be placed adjacent to the forms shall not exceed 2½ inches (63.5 mm) square or the equivalent thereof in cases where circular or rectangular areas are provided. Blocks shall be cast accurately to the thickness required and the surface to be placed adjacent to the forms shall be a true plane, free of surface imperfections. The blocks shall be cured by covering them with wet burlap or mats for a period of 72 hours. Mortar for blocks should contain approximately 1 part hydraulic cement to three parts sand. Concrete for blocks should contain 850 pounds of hydraulic cement per cubic yard (500 kilograms per cubic meter) of concrete.

Individual bar supports shall be placed in rows at 4-ft (1.22 meters) maximum spacing in each direction. Continuous type bar supports shall be placed at 4-ft (1.22 meters) maximum spacing. Continuous bar supports shall be used with permanent metal deck forms.

The exposure of the ends of longitudinals, stirrups and spacers used to position the reinforcement in concrete pipe and in precast box culverts or storm drains is not a cause for rejection.

Reinforcing steel for bridge slabs, top slabs of direct traffic culverts, and top slabs of prestressed box beams at all intersections, except tie only alternate intersections where spacing is less than 1 ft. (300 mm) in each direction.

For steel reinforcing cages for other structural members, reinforcement shall be supported and tied in such a manner that a sufficiently rigid cage of steel is provided. Fasten mats of wire fabric securely at the ends and edges. If the cage is not adequately supported to resist settlement or floating upward of the steel, overturning of truss bars or movement in any direction during concrete placement, permission to continue concrete placement will be withheld until corrective measures are taken. Sufficient measurements shall be made during concrete placement to insure compliance with the above.

No concrete shall be deposited until the Engineer or designated representative has reviewed the placement of the reinforcing steel and all mortar, mud, dirt, etc, shall be cleaned from the reinforcement, forms, workers' boots and tools. Do not place concrete until authorized by the Engineer or designated representative.

406S.9 Handling, Placement and Repair of Epoxy-coated Reinforcement Steel

A. Handling

Systems for handling coated-reinforcement with padded contact areas shall be provided. Handling bands shall be padded to prevent damage to the coating. Bundles of coated reinforcement shall be lifted with a strongback, spreader bar, multiple supports or a platform bridge. The bundled reinforcement shall be carefully transported and stored on protective cribbing. The coated reinforcement should not be dropped or drug during handling.

B. Construction Methods

Coated reinforcement shall not be flame-cut but shall be sawn or shear-cut only when approved. Cut ends shall be coated as specified in Section C, "Repair of Coating".

Coated reinforcement steel shall not be welded or mechanically coupled except where specifically indicated on the drawings. When welding or coupling is indicated on the drawing, the epoxy coating shall be removed at least 6 in. (150 mm) beyond the weld limits before welding and 2 in. (50 mm) beyond the limits of the mechanical coupler before assembly. After the welding or coupling operation is completed the steel shall be cleaned of oil, grease, moisture, dirt, welding contamination (slag or acid residue) and rust to a near-white finish. The existing epoxy coating shall be examined for damage and any damaged or loose epoxy shall be removed to expose sound epoxy coating.

After cleaning the coated-steel, the splice area shall be coated with epoxy repair material to a thickness of 7 to 17 mils (0.18 to 0.43 mm) after curing. A second application of the repair material shall be applied to the bar and coupler interface to ensure complete sealing of the joint.

C. Repair of Coating

The material used for coating repair shall comply with the requirements of this Item and ASTM D3963/D3963M, "Specification for Fabrication and Jobsite Handling of Epoxy-coated Reinforcing Steel Bars". Repairs shall be made in accordance with procedures recommended by the manufacturer of the epoxy coating powder. For areas to be patched, a minimum coating thickness as required for the original coating shall be applied. All visible damage to the coating shall be repaired.

Sawed and sheared ends, cuts, breaks and other damage shall be promptly repaired before additional oxidation occurs. The areas to be repaired shall be cleaned to ensure that they free from surface contaminants. Repairs shall be made in the shop or in the field as required.

406S.10 Measurement

The measurement of quantities of reinforcement furnished and placed will be based on the calculated weight of the steel actually placed as indicated on the drawings, with no allowance made for added bar lengths for splices requested by the Contractor nor for extra steel used when bars larger than those indicated on the drawings are used or for a higher grade of steel that is substituted with the permission of the Engineer or designated representative. Tie wires and supporting devices will not be included in the calculated weights. The calculated weight of bar reinforcement will be determined using the theoretical bar weight set forth in this item.

Measurement required by a change in design will be computed as described above for the actual steel required to complete the work.

406S.11 Payment

This item shall be paid for at the contract unit price bid per pound of "Reinforcing Steel". The unit bid price shall include full compensation for all work specified herein including furnishing, bending, fabricating, welding and placing reinforcement, for all clips, blocks, metal spacers, ties, chairs, wire or other materials used for fastening reinforcement in place and for all tools, labor, equipment and incidentals necessary to complete the work.

Reinforcing steel will generally not be paid for directly, but shall be included in the unit price bid for the items of construction in which the reinforcing steel is used.

When specified in the contract bid form as a separate pay item, this item shall be paid for at the contract unit price bid per pound of "Reinforcing Steel". The unit bid price shall include full compensation for all work specified herein including furnishing, bending, fabricating, welding and placing reinforcement, for all clips, blocks, metal spacers, ties, chairs, wire or other materials used for fastening reinforcement in place and for all tools, labor, equipment and incidentals necessary to complete the work.

Payment, when included as a contract pay item, will be made under:

Pay Item No. 406S-RC:	Reinforcing Steel	Per Pound.
Pay Item No. 406S-ERC:	Epoxy-Coated Reinforcing Steel	Per Pound.

End

SPECIFIC CROSS REFERENCE MATERIALS	
Standard Specification Item 406S, "Reinforcing Steel"	
American Society for Testing and Materials, ASTM	
<u>Designation</u>	<u>Description</u>
ASTM A 36/A 36M	Carbon Structural Steel
ASTM A 82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A 185	Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	Deformed and Plain Billet-steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 775/A 775M	Epoxy-Coated Reinforcing Steel Bars
ASTM A 884/A 884M	Epoxy-Coated Steel Wire and Welded Wire Fabric For Reinforcement
ASTM A 934/A 934M	Epoxy-Coated Prefabricated Reinforcing Steel Bars
ASTM A 996/A 996M	Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM D3963/D3963M	Fabrication and Jobsite Handling of Epoxy-coated Reinforcing Steel Bars
Texas Department of Transportation: Manual of Testing Procedures	
<u>Designation</u>	<u>Description</u>
Tex-739-I	Sampling and Testing Epoxy Coated Reinforcing Steel
City of Austin Standard (Details)	
<u>Designation</u>	<u>Description</u>
Standard 406S-1	Reinforced Steel Tolerances
Texas Department of Transportation: Departmental Material Specifications	
<u>Designation</u>	<u>Description</u>
DMS 8130	Epoxy Powder Coating for Reinforcing Steel
American Welding Society	
<u>Designation</u>	<u>Description</u>
AWS D1.1/D1.1M	Structural Welding Code

RELATED CROSS REFERENCE MATERIALS	
Standard Specification Item 406S, "Reinforcing Steel"	
City of Austin Standard Specification Items	
<u>Designation</u>	<u>Description</u>
Item No. 360	Concrete Pavement
Item No. 403S	Concrete for Structures

Item No. 410S	Concrete Structures
Item No. 414S	Concrete Retaining Walls
Item No. 420S	Drilled Shaft Foundations
Item No. 830S	Traffic Signal Controller Foundation
Item No. 831S	Traffic Signal Drilled Shaft Foundation
Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges	
<u>Designation</u>	<u>Description</u>
Item No. 360	Concrete Pavement
Item No. 420	Concrete Structures
Item No. 421	Hydraulic Cement Concrete
Item No. 422	Reinforced Concrete Slab
Item No. 423	Retaining Walls
Item No. 440	Reinforcing Steels

ITEM NO. 408S CONCRETE JOINT MATERIALS 11-13-07

408S.1 Description

This item shall govern the furnishing and placing of all longitudinal, transverse contraction and expansion joint material in concrete work as herein specified in the various items of these specifications as indicated or as directed by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

408S.2 Submittals

The submittal requirements of this specification item include:

- A. Type and manufacturer of all joint materials proposed for use.
- B. Technical data indicating that proposed products meet the requirements specified herein.

408S.3 Materials

(1) Preformed Asphalt Board

Preformed asphalt board formed from cane or other suitable fibers of a cellular nature securely bound together and uniformly impregnated with a suitable asphaltic binder and meeting the requirements of the Standard Specifications for Preformed Expansion Joint Filler for Concrete (Bituminous Type), ASTM D 994.

(2) Preformed Nonbituminous Fiber Material

Preformed nonbituminous fiber material shall meet the requirements of the Standard Specifications for the Preformed Expansion Joint Filler for Concrete Paving and Structural Construction, ASTM D 1751, except that the requirements pertaining to bitumen content, density and water absorption shall be voided.

(3) Boards

Boards obtained from Redwood timber, of sound heartwood, free from sapwood, knots, clustered birdseye, checks and splits. Occasional sound or hollow birdseye, when not in clusters, will be permitted provided the board is free from any other defects that will impair its usefulness as a joint filler.

(4) Joint Sealer (Concrete Pavement)

This material shall be a one part low modulus silicone especially designed to cure at ambient temperatures by reacting with moisture in the air and shall have the following properties:

As Supplied	
Color	Gray
Flow, MIL-2-8802D Sec. 4.8.4	0.2 maximum
Working Time, minutes	10Tack-Free Time at 77°F 2F (25°C 1.66°C) Min.
MIL-2-8802D Sec.4.8.7	60
Cure time, at 77°F (25°C), days	7-14
Full Adhesion, days	14-21
As Cured—after 7 days at 77°F (25°C) and 40% RH	

Elongation, percent minimum	1200
Durometer Hardness, Shore A, points ASTM 2240	15
Joint Movement Capability, percent	+100/-50
Tensile Strength, maximum elongation,psi (kPa)	100 (689)
Peel Strength, psi (kPa)	25 (172)

The joint sealer shall adhere to the sides of the concrete joint or crack and shall be an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperature.

(5) Backer Rod

Backer Rod shall be expanded closed cell polyethylene foam compatible with sealant. No bond or reaction shall occur between rod and sealant. Backer Rod shall be of sufficient width to be in compression after placement and shall be used with joint sealer.

(6) Joint Sealing Material

Joint Sealing Material for other than pavement use may be a two-component, synthetic polymer or cold-pourable, self leveling type meeting the following requirements:

The material shall adhere to the sides of the concrete joint or crack and shall form an effective seal against infiltration of water and incompressibles. The material shall not crack or break when exposed to low temperatures. Curing is to be by polymerization and not by evaporation of solvent or fluxing of harder particles. It shall cure sufficiently at an average temperature of 77°F 3°F (25°C 1.66°C) so as not to pick up under wheels of traffic in a maximum of 3 hours.

Performance Requirements:

When tested in accordance with Test Method Tex-525-C, the joint sealing material shall meet the above curing times and the requirements as follows:

It shall be of such consistency that it can be mixed and poured or mixed and extruded into joints at temperatures above 60°F (1.66°C).

Penetration 77°F (25°C), 150 gm. Cone, 5 sec., max.-cm	0.90
Bond and Extension 75%, 0F, 5 cycles:	
Dry Concrete Blocks	Pass
Wet Concrete Blocks	Pass
Steel Blocks (Primed if specified by manufacturer)	Pass
Flow at 200 °F (93°C)	None
Water content % by weight, max.	5.0
Resilience:	
Original sample min. % (cured)	50
Oven-aged at 158°F (70°C) min. %	50
For Class 1-a material only, Cold Flow (10 minute)	None

(7) Rebonded Recycled Tire Rubber

This material consists of granular particles of rubber, made by grinding automobile and truck tires, securely bound together by a synthetic resin or plastic binder. The filler must be molded into sheets of the required dimensions, which meet the testing requirements of both ASTM D 1751 and ASTM D 1752, except that the

requirements for asphalt content and expansion are waived. The density of the material must be at least 30 lb/ft³ (440kg/m³).

408S.4 Construction Methods

The Contractor shall install "Concrete Joint Materials" which will function as a compatible system. Joint sealer shall not be placed where a bond breaker is present.

Asphalt, Redwood board or other materials used shall extend the full depth of the concrete and shall be perpendicular to the exposed face. All joints shall be shaped to conform to the contour of the finished section in which they are installed. All material shall be a minimum of ½ inch (12.5 mm) thick or as indicated. Wood materials shall be anchored to the adjacent concrete to permanently hold them in place. Joint sealer shall be installed in accordance with the manufacturer's recommendations.

The material used for side walk expansion joints shall conform to No. 3 above, unless otherwise indicated.

The material used for curb and gutter expansion joints filler shall conform to any of the above, except when placed adjacent to concrete pavement, the joint material shall match the pavement joint material.

408S.5 Measurement and Payment

No additional compensation will be made for materials, equipment or labor required by this item, but shall be included in the unit price bid for the item of construction in which this item is used.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item No. 408S, " Concrete Joint Materials"</u>	
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
D 994	Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
D 1751	Specification for Preformed Expansion Joint Filler for Concrete
	Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752	Specification for Preformed Sponge Rubber and Cork Expansion
	Joint Fillers for Concrete Paving and Structural Construction
D 2240	Standard Test Method for Rubber Property-Durameter Hardness
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-525-C	Tests for Asphalt and Concrete Joint Sealers

ITEM NO. 411S SURFACE FINISHES FOR CONCRETE 11-13-07

411S.1 Description

This item shall govern the furnishing of all materials and the application by the methods of construction indicated on the Drawings for the application of a surface finish to concrete.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

411S.2 Submittals

The submittal requirements of this specification item include:

- A. Type and manufacturer of cement(s).
- B. Type and manufacturer of membrane curing compound.
- C. Type and manufacturer of adhesive grout.
- D. Type and manufacturer of resin paint.
- E. Samples as requested.
- F. Locations of proposed grade/class of finishes.

411S.3 Materials

(1) Masonry Sand

Masonry sand shall conform to ASTM C 144.

(2) White Cement

White cement shall conform to ASTM C 150.

(3) Portland Cement

All cement unless otherwise indicated shall be Portland cement conforming to ASTM C 150.

Portland cement manufactured in a cement kiln fueled by hazardous waste shall be considered as an approved product if the production facility is authorized to operate under regulation of the Texas Natural Resource Conservation Commission (TNRCC) and the U. S. Environmental Protection Agency (EPA). Supplier shall provide current TNRCC and EPA authorizations to operate the facility.

(4) Membrane Curing

Membrane curing shall conform to Item No. 409S, "Membrane Curing".

(5) Adhesive Grout

This subsection sets forth the requirements for three epoxy adhesives with different viscosities designed to bond fresh Portland Cement concrete to existing Portland

Cement concrete, hardened concrete to hardened concrete and steel to fresh or hardened concrete. These adhesives are as follows:

Type V: Standard (medium viscosity) for applying to horizontal and vertical surfaces. This material is suitable for surface sealing of fine cracks in concrete.

Type VI: Low viscosity for application with spray equipment to horizontal surfaces.

Type VII: Paste consistency for overhead application and where a high buildup is required. This material is suitable for surface sealing of cracks in concrete, which are veed out prior to sealing, and for grouting of dowel bars where clearance is 1/16inch (1.6 mm) or less.

- (a) **Mixing Ratio:** The ratio of resin and hardener components to be mixed together to form the finished adhesive shall be either 1 to 1 or 2 to 1 by volume.

Any specific coloring of resin and/or hardener components desired will be stated by the Engineer or designated representative.

Fillers, pigments and thixotropic agents. All fillers, pigments and/or thixotropic agents in either the epoxy resin or hardener component must be of sufficiently fine particle size and dispersed so that no appreciable separation or settling will occur during storage.

Any fillers present in the low viscosity version must be of such a nature that they will not interfere with application by spray equipment or abrade or damage such equipment.

The concrete adhesive shall contain no volatile solvents.

- (b) **Consistency:** The adhesives shall comply with the following:

	Type V	Type VI	Type VII
Viscosity of mixed adhesive 77° ± 1°F, (25° ± -17°C) Poises	400 Maximum	150 Maximum	must be sufficiently fluid to apply by trowel or spatula without difficulty
Pot Life at 77°F (25°C), minutes minimum - 30			
Set Time at 77°F (25°C) (Time required to attain 180 psi (1.3 mPa)), hours maximum - 12			

Thixotropy test shall be performed at both 77° and 120°F (25° and 49°C). Average thickness of cured adhesive remaining on test panel, mils minimum.

Type V	Type VII
30	45

Samples of the individual components in sealed containers shall be maintained at 115° + 3°F (46° + - 16°C) for 2 weeks. The mixed adhesive prepared from these samples must still comply with the minimum thixotropy requirements.

The viscosity of the Type V and Type VI versions must not show an increase of more than 20 percent compared with the viscosity prior to the stability test. The Type VII adhesive must still be sufficiently fluid to apply by trowel or spatula without difficulty.

- (c) **Physical Properties of the Cured Adhesive**

Property	Requirements
Adhesive Shear Strength, psi (mPa), minimum	2200 (15)
Water Gain, percent by weight (mass), maximum	0.20
Ability to bond fresh Portland cement concrete to cured Portland cement concrete psi (mPa), minimum (7 days cure time)	400 (2.8)

(6) Synthetic Resin Paint

Type X Epoxy: This is a high solids epoxy coating designed for application by brush or roller. The materials can also be applied by airless spray by addition of a maximum of 5 percent toluene solvent at the direction of the Engineer or designated representative.

Raw Materials: The basic raw materials to be incorporated into this coating are listed below, along with the specific requirements for each material. The final decision as to the quality of materials shall be made by the Engineer or designated representative. After the Engineer or designated representative has approved the brand names of raw materials proposed by the Contractor, no substitution will be allowed during the manufacture without prior approval of the Engineer or designated representative.

Epoxy Resin: The basic epoxy resin used in the formulation shall be an unmodified liquid resin conforming to the following chemical and physical requirements:

Viscosity at 25.0 + 0.1 C, cps	7,000 to 10,000
Weight per epoxy equivalent, gms per gm - mole	175 to 195
Color (Gardner Number), maximum	5
Hydrolyzable chlorine, maximum % by weight	0.2
Specific gravity, 25/25 degrees	1.14 to 1.18

Test methods to be used in determining these qualities are listed below:

- (a) Viscosity - Test for Kinematic Viscosity (ASTM Designation: D 445).
- (b) Weight per Epoxy Equivalent - Test for Epoxy Content of Epoxy Resins (ASTM Designation: D 1652).
- (c) Color - Test for Color of Transparent Liquids (Gardner Color Scale) (ASTM Designation: D 1544).
- (d) Hydrolyzable Chlorine - Test for Hydrolyzable Chlorine Content of Liquid Epoxy Resins (ASTM Designation D: 1726).
- (e) Specific Gravity - Method of Test for Density of Paint, Varnish, Lacquer and Related Products (ASTM Designation: D 1475).

Pigment

Titanium Dioxide: The titanium dioxide used in this formulation shall be equivalent to DuPont R-900. This shall be a pure, chalk-resistant, rutile titanium dioxide meeting the requirements of ASTM D 476, Type III.

Extender: The extender used in this formulation shall be Nyad 400, manufactured by Interpace Pigments. Specific requirements are as follows:

Particle size distribution	Minimum	Maximum
Minus 20 microns, percent by weight	95	
Minus 10 microns, percent by weight	70	80
Minus 5 microns, percent by weight	40	50
Minus 3 microns, percent by weight	30	40
Minus 1 micron, percent by weight	14	20
Oil Absorption (rub out, lbs/100 lbs)		25 maximum
Brightness (G.E.)	92.5 minimum	

411S.4 Grade of Finish

(1) General

The grade and/or class of finish shall be as described herein and as indicated.

"Grade" of finish designates the areas to which a higher finish is to be applied beyond the requirements of an Ordinary Surface Finish. Four grades of finish are included herein.

"Class" of finish designates the materials or the process to be used in providing the grade of finish. Three classes of finish are included herein.

For structures and surfaces not described herein under grade of finish, a class of finish only may be indicated. Where neither a grade nor class is specified, an Ordinary Surface Finish only will be required as specified in Item No. 410S, "Concrete Structures".

Where the plans specify a grade and class of finish, i.e., Grade II, Class C, only that type of finish shall be furnished.

Where the plans specify a grade of finish only, i.e., Grade I Finish, any of the classes of finish may be furnished. Only one class of finish shall be furnished on any individual structure, twin structures or on structures in close proximity to each other, except as specified for prestressed concrete members below.

(2) Grade I

The following areas shall receive a Class A, B or C (two rub) Finish, except that prestressed members shall receive either a Class A or B Finish only.

All concrete surfaces of railing, including the parapet types; exterior vertical faces of slabs, slab spans, arches and box girders; the outside and bottom surfaces of fascia beams or girders (including prestressed members); the underside of overhanging slabs to the point of juncture of the supporting beam; all exposed vertical surfaces of bents and piers and bottom surfaces of bent caps; all exposed surfaces of tie beams, abutments, bridge wingwalls, culvert headwalls and wingwalls and retaining walls exposed to view after all backfill and is placed.

Unless otherwise indicated, the underside of the slab of slab spans shall be finished its entire width.

Unless otherwise indicated, exposed surfaces of pump houses and other miscellaneous concrete surfaces shall receive a Class A, B or C (one rub) Finish.

(3) Grade II

All concrete surfaces of railing, including the parapet types, all exposed surfaces of bridge wingwalls and the exterior vertical faces of slabs and slab spans shall receive a Class A, B or C (two rub) Finish. All other surfaces described under Grade I Finish shall receive a Class A or B finish only. The underside of slab spans shall receive an Ordinary Surface Finish only.

(4) Grade III

All concrete surfaces of railing, including the parapet types, all exposed surfaces of bridge wingwalls and the exterior vertical faces of slabs shall receive a Class A, B or C (two rub) Finish. All other surfaces described under Grade I Finish shall receive an Ordinary Surface Finish.

(5) Grade IV

The top and roadway faces only of all concrete railing, including the parapet types and bridge wingwalls shall receive a Class A, B or C (one rub) Finish. All other surfaces described under Grade I shall receive an Ordinary Surface Finish.

411S.5 Class of Finish

The Class of Finish designates either an adhesive grout material, a paint-type material or a rubbing process applied to surfaces specified in "Grade of Finish", as required above and/or as indicated.

Unless otherwise indicated the color shall be concrete gray.

(1) Class A

This finish shall consist of an adhesive grout textured coating with a minimum 1/16inch thickness, composed of 1 part white cement, 1 part natural (gray) cement, 2 parts masonry sand, 1 part (latex) emulsion and enough water to form a viscous slurry of a consistency that may be applied by spray gun, brush or roller without appreciable running or sagging. The proportions of white and gray cement may be varied slightly to obtain the desired color.

Gradation of the masonry sand shall be as required to produce a texture satisfactory to the Engineer or designated representative.

Prepackaged materials meeting these requirements and acceptable to the Engineer or designated representative as to color, texture and appearance will be permitted.

(2) Class B

The finish shall be a paint-type material, consisting of a synthetic resin, containing fibrous as well as texturing pigments, which when applied by a 1 coat spray application at the rate of 45 ± 5 square feet per gallon (15.9 ± 1.9 square meters per liter) yield an acceptable textured coating. Certification by the manufacturer of the above materials will be required.

(3) Class C

This finish shall consist of a one rub or two rub system, as the case may be, meeting the requirements set forth below under "Construction Methods".

411S.6 Approval of Surface Finishing Materials

The material to be furnished shall meet the requirements of TxDOT Specification DMS-8110, Structural Coatings, latest revision.

In addition to the above, the manufacturer shall furnish the following:

- (1) At the time of original request for approval of the surface furnishing material, the manufacturer shall supply a 1-gallon (3.8 L) sample of the material to the Engineer or designated representative, if requested.
- (2) Each 6 months after approval of the material, the manufacturer shall furnish a notarized certification indicating that the material originally approved has not been changed or altered in any way. Any change in formulation of a surface finish shall require retesting prior to use.

The Engineer or designated representative may request additional information to be submitted such as infrared spectrophotometry scan, solids content, etc., for further identification. A change in formula discovered by any of the tests prescribed herein or by other means and not reported and retested, may be cause to permanently bar the manufacturer from furnishing surface finish materials for City work.

The City reserves the right to perform any or all of the tests required by this specification as a check on the tests reported by the manufacturer. In case of any variance the City tests will govern.

411S.7 Construction Methods

Prior to application of any of the finishes required herein, concrete surfaces shall be given an Ordinary Surface Finish. For Class A and B materials, concrete surfaces shall be clean and free of dirt, grease, curing compound or any other bond breaking substance. Class A shall be applied on moistened surfaces but Class B requires a dry surface. The temperature of the atmosphere, concrete and compound shall be above 50°F (10°C) for Classes A and B at the time of application. The finished surfaces shall be protected against rain or freezing for a period of 24 hours after application.

Class A materials shall be applied by spraying, by roller or by brush. Class B materials shall be applied by spraying only. All applications shall provide an acceptable texture of the proper coverage.

The Class A and B material shall be applied after all preparation work required by Ordinary Surface Finish has been completed.

The Class C Finish shall be performed with a carborundum stone as follows, after all preparatory work required by Ordinary Surface Finish has been completed:

For a two-rub system, the first rubbing shall bring the wetted concrete face to a paste and produce a smooth dense surface without pits, form marks or other irregularities. The use of cement or grout to form the paste will not be permitted. Striping with a brush and washing after the first rubbing will not be required. Chamfer lines shall be finished during the second rubbing.

The first rubbing shall be done soon after form removal. Membrane curing, if used, shall be applied after the first rub is complete. Prior to the second rubbing, any remaining curing membrane shall be removed from the surface by brushing, buffing or other satisfactory methods.

The second rubbing shall be performed when conditioning the structure for final acceptance. The specified surfaces shall be cleaned of drip marks and discolorations and given a final rubbing. The surface shall be striped neatly with a brush and the paste allowed to take a reset, after which the surfaces shall be washed with clean water leaving them with a neat and uniform appearance and texture.

For a one rub system, the rubbing requirements shall be the same as for the first rub above, except chamfer lines shall be finished and the paste spread uniformly, striped with a brush and allowed to take a reset after which the surfaces shall be washed with clean water leaving them with a neat and uniform appearance and texture.

411S.8 Special Surfaces Finishes

(1) General

When special surface finishes are required for retaining walls, panels, copings or similar construction, the Contractor shall prepare sample panels for approval of the finish and the method of application. Unless otherwise indicated, panel or pattern arrangement and dimensions may be varied to achieve a more pleasing appearance or to utilize forming material more efficiently when approved by the Engineer or designated representative. Aggregates, materials, variation of panel or pattern arrangement, dimensions and other features affecting the work shall be approved prior to start of the work.

(2) Striated Finish

The striated (grooved) pattern shall be as indicated or as approved by the Engineer or designated representative.

The finish shall be made by lining the forms with striated sheets of plywood, plastic, fiberglass, metal or other material acceptable to the Engineer or designated representative. The striations on the panels shall be of a smooth, wide pattern, not sharp or angular.

A chamfer groove shall be used along all edges of each panel. All ties, bolts or other forming accessories shall be located along the chamfer grooves or panel edges.

(3) Exposed Aggregate Finish

(a) Structural Concrete

Exposed aggregate panels may be either raised, recessed or as indicated with the sides of each panel chamfered as directed by the Engineer or designated representative.

The aggregate used for this finish shall be approved by the Engineer or designated representative. Unless otherwise indicated, aggregate shall conform to the grading requirements of Grade 2 aggregate except that a minimum of 50 percent shall be retained on the ¾-inch (19 mm) sieve. Gravel of predominately rounded particles shall be used, except that when indicated or approved by the Engineer or designated representative in writing, crushed stone may be used. The aggregate shall be large enough to remain firmly anchored in the face of the final product. The depth shall be ¼-inch (6.4 mm) minimum to ½-inch (12.7 mm) maximum, unless otherwise indicated or directed by the Engineer or designated representative.

A surface retarder that penetrates the concrete approximately ¼ (6.4 mm) inch shall be applied to the forms or concrete surface as an aid in achieving the desired finish. Wood forms may require 2 or 3 coatings to compensate for absorption. Form joints shall be taped or caulked to prevent escape of the retarder during placing operations.

Treated form surfaces shall be protected from sun and rain while exposed to the atmosphere. In case of high humidity or if rain has dampened the forms prior to placing concrete, a reapplication of the surface retarder may be required to provide uniform coverage of the retarder on the forms.

Adjacent areas of fresh concrete not requiring exposed aggregate finish shall be protected when the retarder is applied.

The finish shall be obtained by sandblasting, bush hammering, water blasting or other methods, as approved by the Engineer or designated representative. Horizontal surfaces may be finished by a combination of brushing and washing, but only after the concrete has set sufficiently to prevent loosening of the aggregate.

Unless otherwise directed by the Engineer or designated representative, forms for surface requiring exposed aggregate finish shall be removed 12 to 15 hours after concrete placement. The exposed aggregate operation shall be accomplished immediately after form removal. Except for the time required for obtaining the exposed aggregate finish, curing of all surfaces shall be maintained for the minimum 4 day curing time. All surfaces shall be either water cured or may be cured with an approved clean membrane compound. If water curing is used, it shall be followed by a clear membrane curing compound conforming to Item No. 409S, "Membrane Curing".

Care shall be taken to ensure proper vibration at all points of concrete placement to prevent honeycomb or segregation of the materials. Vibration shall be done in such a manner as to provide adequate penetration of previously placed concrete lifts. Care shall be taken to prevent contact of the vibrator with the face form.

(b) Sidewalks

When exposed aggregate surfaces are required for sidewalks, driveways and/or medians, the coarse aggregate shall consist of particles with at least 40 percent crushed faces. Uncrushed gravel, polished aggregates and clear resilient coatings are not acceptable. Grade 5 coarse aggregates shall be used for exposed aggregate finishes for sidewalks, driveways and/or medians.

411S.9 Measurement and Payment

No direct measurement or payment will be made for the work to be done, the equipment or materials to be furnished under this item, but shall be included in the unit price bid for the item of construction in which this item is used.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item No. 411S, " Surface Finishes for Concrete"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 410S	Concrete Structures
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
DMS-8110	Coatings for Concrete
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
C 144	Aggregate for Masonry Mortar
C 150	Portland Cement
D 445	Kinematic Viscosity of Transparent and Opaque Liquids
D 476	Standard Classification for Dry Pigmentary Titanium Dioxide Products
D 1475	Standard Test Method for Density of Liquid Coatings, Inks and Related Products
D 1544	Standard Test Method for Color of Transparent Liquids (Gardner Color Scale)
D 1652	Standard Test Method for Epoxy Content of Epoxy Resins
D 1726	Standard Test Method for Hydrolyzable Chloride Content of Liquid Epoxy Resins

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item No. 411S, " Surface Finishes for Concrete"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures
Item No. 410S	Concrete Structures
Item No. 411S	Surface Finished for Concrete

ITEM NO. 430S P.C. CONCRETE CURB AND GUTTER 11-15-11

430S.1 Description

This item shall govern Portland Cement (p.c.) concrete curb, p.c. concrete curb and gutter with reinforcing steel or p.c. concrete laydown curb as required, that is constructed in accordance with this specification on an approved subgrade and base in conformity with Standard Detail Series 430S and the lines, grades, section indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

430S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p.c. concrete mix design,
- B. Type of Installation (i.e. P.C. Concrete Curb and Gutter or P.C. Concrete Curb or P.C. Concrete Laydown Curb) and construction details (i.e. base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

430S.3 Materials

- A. Concrete

The Portland cement (p.c.) concrete shall conform to Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures" or Sections 360S.4 and 360S.6 of Standard Specification Item No. 360S, "Concrete Pavement" when curb and gutter is to be constructed integral with the pavement.

- B. Reinforcing Steel

Reinforcing steel shall conform to Standard Specification Item No. 406S, "Reinforcing Steel."

- C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Expansion Joint Materials."

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing."

- E. Flexible Base

Aggregate shall conform to Standard Specification Item No. 210S, "Flexible Base".

430S.4 Construction Methods

- A. Subgrade and Base Preparation

Subgrade for curb and gutter shall be excavated and prepared to depth and width requirements indicated on the Drawings, including a minimum of 12 inches (300 mm) behind the curb, unless a greater width is indicated on the Drawings. The subgrade shall be shaped to the line, grades, cross section and dimensions

indicated on the Drawings. A minimum of 4 inches (100 mm) of flexible base shall be spread, wetted and thoroughly compacted under curb and gutter as specified in Standard Specification Item No. 210S, "Flexible Base". If dry, the base shall be sprinkled lightly with water before p.c. concrete is deposited thereon.

B. C & G Forms

Forms shall be of metal, well-seasoned wood or other approved material. The length of the forms shall be a minimum of 10 feet (3 meters). Flexible or curved forms shall be used for curves of 100-foot (30 meter) radius or less. Wood forms for straight sections shall be not less than 2 inches (50 mm) in thickness. Forms shall be a section, that is satisfactory to the Engineer or designated representative, of the depth required and clean, straight, free from warp and, if required, oiled with a light form oil. All forms shall be securely staked to line and grade and maintained in a true position during the placement of p.c. concrete.

C. Reinforcing Steel

The reinforcing steel, if required, shall be placed as shown on the typical section of the Drawings. Care shall be exercised to keep all steel in its proper location during p.c. concrete placement.

D. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, $\frac{3}{4}$ inch (19 mm) in thickness, shall be provided at intervals not to exceed 40 feet (12 meters) and shall extend the full width and depth of the p.c. concrete. Weakened plane joints shall be made $\frac{3}{4}$ inch (19 mm) deep at 10-foot (3 meters) intervals. All joint headers shall be braced perpendicular and at right angles to the curb.

Two round smooth dowel bars, $\frac{1}{2}$ inch (12.5 mm) in diameter and 24 inches (600 mm) in length, shall be installed at each expansion joint. Sixteen inches (400 mm) of one end of each dowel shall be thoroughly coated with hot oil, asphalt or red lead, so that it will not bond to the concrete. The dowels shall be installed with a dowel sleeve on the coated end as indicated on the Drawings or equivalent method as directed by the Engineer or designated representative.

E. P.C. Concrete Placement and Form Removal

Concrete shall be placed in the forms and properly consolidated. Within 1 hour after p.c. concrete placement, a thin coating, that is no more than $\frac{1}{2}$ inch (12.5 mm) nor less than $\frac{1}{4}$ inch (6.25 mm) thick of finish mortar, composed of 1 part Portland Cement to 2 parts fine aggregate, shall be worked into the exposed faces of the curb and gutter by means of a "mule". After the p.c. concrete has become sufficiently set, the exposed edges shall be rounded by the use of an edging tool to the radii indicated on Standard Detail 430S-1. The entire exposed surface of the curb and gutter shall be floated to a uniform smooth surface, and then finished with a camel hairbrush to a gritty texture. The forms shall remain in place a minimum of 24 hours unless approved otherwise by the Engineer or designated representative.

After removal of the forms, any minor honeycombed surfaces shall be plastered with a mortar mix as described above. Excessively honeycombed curb and gutter, as determined by the Engineer or designated representative, shall be completely removed and replaced when directed.

F. Curing

Immediately after finishing the curb, concrete shall be protected by a membrane curing conforming to Standard Specification Item No. 409S, "Membrane Curing."

After a minimum of 3 days curing and before placement of the final lift of the base course, the curb shall be backfilled to the full height of the p.c. concrete, tamped and sloped as directed by the Engineer or designated representative. The upper 4 inches (100-mm) of backfill shall be of clean topsoil that conforms to Standard Specification Item No. 130S, "Borrow" and is free of stones and debris.

G. Seeding in Turf Areas

When turf is to be established, preparation of the seedbed shall conform to Item No. 604S, "Seeding for Erosion Control".

430S.5 Measurement

Accepted work as prescribed by this item will be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) of p.c. concrete curb and gutter, p.c. concrete curb and/or p.c. concrete laydown curb, complete in place.

430S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per lineal foot for "P.C. Concrete Curb and Gutter" or P.C. Concrete Curb. The price shall include full compensation for all work as set forth and described under payment Method A and/or B.

A. Method A (Pay Item No. 430S-A)

This payment method shall include all the work performed for "P.C. Concrete Curb and Gutter" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, preparation of the subgrade, furnishing and placing all concrete and base material, reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

B. Method B (Pay Item No. 430S-B)

This payment method includes all the work performed for "P.C. Concrete Curb and Gutter", complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing concrete and reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

C. Method C (Pay Item No. 430S-C)

This payment method includes all the work performed for "P.C. Concrete Curb" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, furnishing and placing all concrete and base material, reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

D. Method D (Pay Item No. 430S-D)

This payment method includes all the work performed for "P.C. Concrete Curb" complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing concrete and reinforcing steel, dowels, expansion joint material, curing material, backfill and for other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

E. Method E (Pay Item No. 430S-E)

This payment method shall include all the work performed for "P.C. Concrete Laydown Curb" complete, at the unit bid price. The unit bid price shall include full compensation for excavation, preparation of the subgrade, furnishing and placing all concrete and base material, reinforcing steel, dowels, expansion joint material, curing material, backfill and for all other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

F. Method F (Pay Item No. 430S-F)

This payment method includes all the work performed for "P.C. Concrete Laydown Curb" complete, at the unit bid price. The unit bid price shall include full compensation for fine grading, furnishing and placing

concrete and reinforcing steel, dowels, expansion joint material, curing material, backfill and for other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

Pay Item No. 430S-A:	P.C. Concrete Curb and Gutter (Excavation)	Per Lineal Foot.
Pay Item No. 430S-B:	P.C. Concrete Curb and Gutter (Fine Grading)	Per Lineal Foot.
Pay Item No. 430S-C:	P.C. Concrete Curb (Excavation)	Per Lineal Foot.
Pay Item No. 430S-D:	P.C. Concrete Curb (Fine Grading)	Per Lineal Foot.
Pay Item No. 430S-D:	P.C. Concrete Curb (Fine Grading)	Per Lineal Foot.
Pay Item No. 430S-E:	P.C. Concrete Laydown Curb (Excavation)	Per Lineal Foot.
Pay Item No. 430S-F:	P.C. Concrete Laydown Curb (Fine Grading)	Per Lineal Foot.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Item No. 430S, "P.C. Concrete Curb and Gutter"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No 130S	Borrow
Item No 210S	Flexible Base
Item No. 360	Concrete Pavement"
Section 360.4 of Item 360	Proportioning of Concrete
Section 360.6 of Item 360	Concrete Mixing and Placing
Item No. 403S	Concrete for Structures
Section 403S.7 of Item No. 403S	(Table 4)
Item No. 406S	Reinforcing Steel
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 604S	Seeding for Erosion Control
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
430S-1	Curb and Gutter Section
430S-3	Curb Expansion Joint Dowel Detail
430S-4	Concrete Backfill Under Curb & Gutter
430S-5	Reinforcing Bar Detail at Existing Curb and Gutter

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item No. 430S, "P.C. Concrete Curb and Gutter"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 302S	Aggregates for Surface Treatments
Item No. 340S	Hot Mix Asphaltic Concrete Pavement

Item No. 431S	Machine Laid PCC Curb and Gutters
Item No. 433S	P.C. Concrete Driveways
Item No. 434S	P.C. Concrete Medians and Islands
Item No. 436S	P.C. Concrete Valley Gutters
Item No. 606S	Fertilizer

ITEM NO. 432S PORTLAND CEMENT CONCRETE SIDEWALKS 1-4-10

432S.1 Description

This item shall govern the construction of Portland cement concrete sidewalks (Standard Detail No. 432S-1), as herein specified, on an approved subgrade and in conformance with the lines, grades and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text inch-pound units are given preference followed by SI units shown within parentheses.

432S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A portland cement (p.c.) concrete mix design,
- B. Type of Installation (i.e. Type I, Type II, etc.) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding,
- D. Number, manufacturer, model, construction, finish and installation details of streetscape appurtenances of bicycle racks, benches, chairs, trash receptacles, streetlights, tree wells and above grade tree planters [for sidewalks, 12 feet (3.66 meters) or wider].

432S.3 Materials

- A. Portland Cement Concrete
Portland cement concrete shall be Class A conforming to Specification Item No. 403S, "Concrete for Structures" or Specification Item No. 407S, "Fibrous Concrete."
- B. Reinforcement
Reinforcement shall conform to Specification Item No. 406S, "Reinforcing Steel" or Specification Item No. 407S, "Fibrous Concrete."
- C. Expansion Joint Materials
Expansion joint materials shall conform to Specification Item No. 408S, "Expansion Joint Materials."
- D. Membrane Curing Compound
Membrane curing compound shall conform to Specification Item No. 409S, "Membrane Curing."

432S.4 Construction Methods

The subgrade shall be excavated in accordance with Specification Item No. 111S, "Excavation," prepared in accordance with Specification Item No. 201S, "Subgrade Preparation," shaped to the lines, grades and cross section as indicated on the Drawings or as directed by the Engineer or designated representative and thoroughly compacted in accordance with Specification Item No. 201S. A granular cushion of a minimum thickness of 2 inches (50 mm) but maximum thickness of 5 inches (125 mm), composed of crusher screenings, gravel and sand, crushed

rock or coarse sand, shall be spread, wetted thoroughly, tamped and leveled. The granular cushion shall be moist at the time the Portland cement concrete is placed.

If the subgrade is undercut by more than 4 inches (100 mm) or the elevation of the natural ground is more than 4 inches (100 mm) below "top of subgrade," then a necessary backfill/embankment layer of an approved material shall be placed and compacted with a mechanical tamper. Hand tamping will not be permitted.

Where the subgrade is rock or gravel, 70% of which is rock; the 2-inch (50 mm) cushion need not be used. The Engineer or designated representative will determine if the subgrade meets the above requirements.

Sidewalk forms shall be constructed of metal or well-seasoned wood not less than 2 inches (50 mm) in thickness, with a section satisfactory to the Engineer or designated representative. The forms shall be clean, straight, and free from warp with a depth equal to the thickness of the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the deposition of Portland cement concrete. Before p.c. concrete is placed, the forms shall be thoroughly oiled with a light form oil.

Expansion joint material $\frac{3}{4}$ inch (19 mm) thick, shall be provided where the new construction abuts an existing structure, sidewalk or driveway. Similar expansion material shall be placed around all obstructions protruding through the sidewalk. The expansion joint material shall be placed vertically and shall extend the full depth of the p.c. concrete. Maximum spacing of expansion joints shall be 40 feet (12 meters) as indicated on the Drawings or as directed by the Engineer or designated representative. Weakened plane joints shall be spaced at 5 feet (1.5 meters) on center. Normal dimensions of the weakened plane joints shall be $\frac{1}{4}$ inch wide and $\frac{3}{4}$ inch deep (6 mm wide and 19 mm deep). All joints shall be constructed perpendicular (90 degrees) to the centerline of walk and shall match any previously placed concrete joints. For sidewalks with widths exceeding 6 feet (1.83 meters) longitudinal weakened-plane tooled joints shall be provided as indicated on the Drawings or as directed by the Engineer or designated representative.

Reinforcement for sidewalks shall consist either of polypropylene fibrillated fibers or 6" x 6" x W1.4 x W1.4 (150mm x 150mm x MW9 x MW9) welded wire fabric or one layer #3 (10M) reinforcing bars, placed no more than 18 inches (450 mm) on center both directions. All reinforcement shall be accurately placed at slab mid-depth, equidistant from the top and bottom of the p.c. concrete and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the steel at its proper position during the placement of the p.c. concrete. In no instance shall the steel be placed directly on the subgrade or sand cushion layer.

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to ensure conformance with the drawings, specifications and this item. In addition, care shall be exercised to keep all steel in its proper position during placement of the p.c. concrete. If during placement of the concrete, the reinforcement is observed to loose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

Splices in wire fabric shall overlap sufficiently to allow two pairs of transverse wires to be tied together and no splice of less than 6 inches (150 mm) will be permitted. Splices in the #3 (10M) bars shall have a minimum lap of 12 inches (300 mm).

Where driveways cross sidewalks, additional reinforcing shall be placed in the sidewalk as indicated on the Drawings.

Portland cement concrete sidewalk ramps shall be formed to produce a finished surface with detectable warnings (Standard Detail 432S-2A) in accordance with the requirements of the American Disabilities Act and Texas Accessibility Standards (TAS), including Sections 4.29.2 and A4.29.2. The p.c. concrete sidewalk ramps shall be constructed in accordance with appropriate City of Austin Standard Details (Standard Details 432S-3, 432S-3A through 432S-3H, 432S-5, 432S-5A, 432S-5B, etc.).

Detectable warning for the ramps shall consist of raised truncated domes with a diameter of nominal 0.9 inch (23 mm), a height of nominal 0.2 inch (5 mm) and center-to-center spacing of nominal 2.35 inches (60 mm) and shall

contrast visually with adjoining surfaces, either light on dark or dark-on-light. The material used to provide contrast shall be an integral part of the walking surface.

When indicated on the Drawings or as directed by the Engineer or designated representative, the construction of the sidewalk ramp shall include the installation of interlocking concrete paving units (Standard Specification Item No. 480S, "Concrete Paving Units"). The concrete paving units shall be constructed in accordance with Standard Specification Item No. 485S, "Concrete Paving Units for Sidewalk Ramps" and appropriate City of Austin Standard Details (Standard Details 432S-2A, 432S-3, 432S-3A through 432S-3H, 432S-5, 432S-5A and 432S-5B).

At the proper time after finishing, the surface shall be protected by a membrane, compound curing agent or by wetted cotton or burlap mats, conforming to Item No. 409S, "Membrane Curing." The sides of the p.c. concrete shall be cured in the forms. If the forms are removed during the curing process, the curing shall be continued by the placement of fill against the exposed concrete edges or by other procedures conforming to Item No. 410S, "Concrete Structures." The top 4 inches (100 mm) of fill shall be clean topsoil conforming to Item No. 604S, "Seeding for Erosion Control."

Existing sidewalk that is scheduled for removal and replacement shall be removed and the underlying material shaped to the lines, grades and cross section as indicated in the drawings or as directed by the Engineer or designated representative. The removal and/or relocation of obstructions, including but not limited to signs, trash cans and benches on concrete pads, abandoned manholes, sprinkler control valves and landscaping, shall be performed, as indicated on the drawings, in a manner acceptable to the Engineer or designated representative. Removal and/or relocation of obstructions will be considered incidental work to this item and will not be paid for directly.

Existing PVC pipe drains in and behind curb shall be removed and replaced as required in new sidewalk and/or curb and gutter. In areas of proposed sidewalk construction, where curb and gutter is to remain in place, existing PVC pipe shall be cut far enough behind the back of curb to allow sufficient room for joint fittings to connect to new or salvaged PVC pipe.

The Contractor shall be responsible for removing and replacing mailboxes that are located in the construction area, while assuring that mail delivery will not be interrupted as a result of the construction activities. Mailboxes shall not be laid on the ground.

All necessary excavation, filling and grading of the slopes adjacent to the completed concrete sidewalks will be considered incidental work pertaining to this item and will not be paid for directly. The adjacent excavation and grading of the slopes shall be done in a manner acceptable to the Engineer or designated representative.

432S.5 Streetscape Furniture Installation Requirements

A. General

Bicycle racks, benches and chairs, trash receptacles, tree wells and above grade tree wells and planters shall only be installed in sidewalks that are 12 feet (3.66 meters) or wider. When installation is indicated on the Drawings or directed by the Engineer or designated representative, these items shall be permanently installed as indicated in Standard Details 710S-4 and 710S-5; 432S-9B; 432S-7C, 432S-7F; and 432S-8B. Above grade tree wells shall be installed in conformance with Standard Detail 432S-7E, while above grade tree planters shall be installed in conformance with Standard Detail Nos. 432S-7D and 432S-7G.

B. Location Requirements

1. Benches.

Benches shall be placed either perpendicular to the curb with the center of the bench on line with trees and light poles and facing toward the building entry, or parallel to the building and within 6" (150 mm) of the building wall, facing out to the street.

Bench siting shall be in conformance with Standard Detail No. 432S-9C in 12' (3.6 M) or wider sidewalks and Standard Detail No. 432S-9D in sidewalks of width between 12' (3.6 M) and 18' (5.4 M).

2. Bike Racks.

Bike racks are to be placed perpendicular to the curb with the centerline of the rack on line with trees and light poles.

Bike rack siting shall be in conformance with Standard Detail No. 710S-6A in 12' (3.6 M) or wider sidewalks and Standard Detail No. 710S-6B in sidewalks of width between 12' (3.6 M) and 18' (5.4 M).

3. Trash Receptacles.

Trash receptacles shall either be placed along the curb, with the center line of the receptacle on line with the trees and light poles, or shall be located at the building entry in alignment with the structural bay system of the building. If located at the entry there shall be no more than 1 foot (300 mm) clearance between the receptacle and the building wall.

Trash receptacle siting adjacent to curb ramps within an intersection shall be in conformance with Standard Detail No. 432S-8C in 12' (3.6 M) or wider sidewalks.

432S.6 Pedestrian Railing

When a pedestrian railing installation is required along sidewalks for pedestrian protection as indicated on the Drawings or directed by the Engineer or designated representative, this type of pedestrian railing shall be permanently installed in conformance with one of the following designated Standard Details: 707S-1, 707S-2, 707S-3 or 707S-4.

When a pedestrian railing installation is required along portions of sidewalks identified as 'ramps' for ADA accessibility purposes as indicated on the Drawings or directed by the Engineer or designated representative, this type of pedestrian railing shall be permanently installed in conformance with one of the following designated Standard Details: 707S-2, 707S-3 or 707S-4.

432S.7 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meter: 1 square meter is equal to 10.764 square feet) of surface area of "Concrete Sidewalk."

Accepted work performed as prescribed by "Sidewalk Ramps" will be measured per each for the type of ramp indicated on the Drawings.

Accepted work performed as prescribed by "Streetscape Appurtenances" will be measured per each for the type of appurtenance indicated on the drawings.

Accepted work performed as prescribed by "Pedestrian Railing" will be measured per lineal foot of the type of railing indicated on the Drawings.

432S.8 Payment

The work performed as prescribed by this item for concrete sidewalk will be paid for at the unit bid price per square foot for "Concrete Sidewalk" and/or "Sidewalks Reconstruction"; per each for "Concrete Sidewalk Ramps" and "Streetscape Appurtenances" or per lineal foot for "Pedestrian Railing".

The unit bid price for new sidewalk shall include full compensation for excavating and/or removal and/or relocating obstructions, vegetating adjacent areas disturbed by sidewalk construction, preparing the subgrade; for furnishing and placing all materials including cushion material, all reinforcement, bar supports, joints, expansion

joint materials, and for any other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

The unit bid price for sidewalk reconstruction shall include full compensation for excavating and/or removal of existing sidewalk and other obstructions, relocating obstructions, replacing PVC drain pipe, re-vegetating adjacent areas disturbed by sidewalk construction, preparing the subgrade; for furnishing and placing all materials including cushion material, all reinforcement, bar supports, joints, expansion joint materials, and for any other materials, manipulations, labor, tools, equipment, finishing, curing and incidentals necessary to complete the work.

The unit bid price for ramps shall include full compensation for preparing the subgrade when not included as a separate item; for furnishing and placing all materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work. All necessary excavation, filling and grading of the slopes adjacent to the completed concrete paver units will be included in the unit price bid for the item of construction in which this item is used, unless included as a separate pay item in the Contract bid form.

The unit bid price for streetscape appurtenances shall include full compensation for the individual item (i.e. bench, chair, bicycle rack, trash receptacle, street light or above grade tree planter), as well as the removal of existing sidewalk, preparation of footings, furnishing and placing all materials, manipulation and finishing, labor, tools, equipment and incidentals necessary to complete the work.

The unit bid price for pedestrian railing shall include full compensation for the complete installation of the specific pedestrian railing including but not limited to preparation of footings or curb, furnishing and placing all materials, manipulation and finishing, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

New Sidewalks		
Pay Item 432S-4:	New P.C. Concrete Sidewalks, 4 Inch thickness	Per Square Foot.
Pay Item 432S-5:	New P.C. Concrete Sidewalks, 5 Inch thickness	Per Square Foot.
Pay Item 432S-6:	New P.C. Concrete Sidewalks, 6 Inch thickness	Per Square Foot.
Pay Item 432S-7:	New P.C. Concrete Sidewalks, 7 Inch thickness	Per Square Foot.
Sidewalks Reconstruction		
Pay Item 432SR-4:	Reconstruct Concrete Sidewalks to 4 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Pay Item 432SR-5:	Reconstruct Concrete Sidewalks to 5 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Pay Item 432SR-6:	Reconstruct Concrete Sidewalks to 6 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Pay Item 432SR-7:	Reconstruct Concrete Sidewalks to 7 Inch thickness, including removal of existing sidewalk	Per Square Foot.
Ramps		
Pay Item 432S-RP-1:	P.C. Sidewalk Curb Ramp with Pavers (Type I)	Per Each.
Pay Item 432S-RP-1A:	P.C. Sidewalk Curb Ramp with Pavers (Type IA)	Per Each.
Pay Item 432S-RP-1B:	P.C. Sidewalk Curb Ramp with Pavers (Type IB)	Per Each.
Streetscape Appurtenances		
Pay Item 432S-SAC-1:	Streetscape Bench (___ inches in length)	Per Each.
Pay Item 432S-SAC-2:	Streetscape Chair	Per Each.

Pay Item 432S-SAC-3:	Streetscape Bicycle Rack	Per Each.
Pay Item 432S-SAC-4:	Streetscape Trash Receptacle	Per Each.
Pay Item 432S-SAC-5:	Streetscape Street Light	Per Each.
Pay Item 432S-SAC-7C:	Streetscape Tree Well for Concrete Sidewalks	Per Each.
Pay Item 432S-SAC-7D:	Streetscape Above Grade Tree Planters	Per Each.
Pay Item 432S-SAC-7E:	Streetscape Tree Well with Seat	Per Each.
Pay Item 432S-SAC-7F:	Streetscape Tree Well without Grate	Per Each.
Pay Item 432S-SAC-7G:	Streetscape Above Grade Galvanized Steel Tree Planters	Per Each.
Pedestrian Railing		
Pay Item 432S-PRC-1:	Pedestrian Railing (Standard 707S-1)	Per LF.
Pay Item 432S-PRC-2:	Pedestrian ADA Railing - Option 1 (Standard 707S-2)	Per LF.
Pay Item 432S-PRC-3:	Pedestrian ADA Railing - Option 2 (Standard 707S-3)	Per LF.
Pay Item 432S-PRC-4:	Pedestrian ADA Railing - Option 3 (Standard 707S-4)	Per LF.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 432S, "Portland Cement Concrete Sidewalks"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 111S	Excavation
Item No. 201S	Subgrade Preparation
Item No. 403S	Concrete for Structures
Item No. 406S	Reinforcing Steel
Item No. 407S	Fibrous Concrete
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures
Item No. 480S	Concrete Paving Unit
Item No. 485S	Concrete Paving Units for Sidewalk Ramps
Item No. 604S	Seeding for Erosion Control
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
432S-1	Sidewalk
432S-2A	Detectable Warning-Paver
432S-3	Type I Curb Ramps-Full Intersection
432S-3A	Type I Curb Ramps-T Intersection
432S-3B	Type IA/IB Curb Ramps-Full Intersection
432S-3C	Type IA/IB Curb Ramps-T Intersection
432S-3D	Combined Curb Ramps-Full Intersection
432S-3E	Combined Curb Ramps-T Intersection
432S-3F	Combined Sidewalk Curb Ramp with Pavers
432S-3G	Combined Sidewalk Curb Ramp with Pavers within Limited ROW

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432S-3H	Type I Curb Ramps within PC/PT of Curb and Gutter
432S-5	Type I Sidewalk Curb Ramp
432S-5A	Type IA Sidewalk Curb Ramp
432S-7C	Tree Well for New Trees Planted Within Concrete Sidewalk 3.6 M (12') or Greater
432S-7D	Above Grade Tree Planters
432S-7E	Above Grade Tree Well with Bench
432S-7F	Tree Well Without Grate
432S-7G	Above Grade Galvanized Steel Tree Planters
432S-8B	Trash Receptacle Installation in Concrete Sidewalk
432A-8C	Furnishing Location in 12' (3.6 M) or greater Trash Receptacle Siting
432S-9B	Bench/Chair Installation in Sidewalks
432S-9C	Furnishing Location in 12' (3.6 M) or greater Sidewalks-Bench Siting
432S-9D	Furnishing Location in Greater than 12' (3.6 M) or Less than 18' (5.4 M) Sidewalks-Bench Siting
707S-1	Pedestrian Railing
707S-2	Pedestrian ADA Railing - Option 1
707S-3	Pedestrian ADA Railing - Option 2
707S-4	Pedestrian ADA Railing - Option 3
710S-4	Bicycle Rack Installation in Concrete Sidewalks (Alternate 1)
710S-5	Bicycle Rack Installation in Concrete Sidewalks (Alternate 2)
710S-6A	Furnishing Location in 12' (3.6 M) or greater Sidewalks-Bicycle Rack Siting
710S-6B	Furnishing Location in Greater than 12' (3.6 M) or Less than 18' (5.4 M) Sidewalks-Bicycle Rack Siting

American Disabilities Act, Federal Register; Volume 56, No. 144; July 26, 1991 ADA Accessibility Guidelines For Building And Facilities

<u>Designation</u>	<u>Description</u>
Section 4.29	Detectable Warnings on Walking Surfaces
Section A4.29.2	Detectable Warnings on Walking Surfaces

Architectural Barriers; Texas Civil Statutes, Article 9102; June 14, 1995 Texas Accessibility Standards (TAS)

<u>Designation</u>	<u>Description</u>
Section 4.29	Detectable Warnings on Walking Surfaces
Section A4.29.2	Detectable Warnings on Walking Surfaces

RELATED CROSS REFERENCE MATERIALS

Specification 432S, "Portland Cement Concrete Sidewalks"

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City of Austin Standard Contract Documents

<u>Designation</u>	<u>Description</u>
00700	General Conditions
01500	Temporary Facilities
01550	Public Safety and Convenience

City of Austin Utilities Criteria Manual

<u>Designation</u>	<u>Description</u>

Section 5.2.3	Utility Adjustments For Roadway Construction Projects
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Portland Cement Concrete
Item No. 110S	Street Excavation
Item No. 132S	Embankment
Item No. 203S	Lime Treatment for Materials In Place
Item No. 204S	Portland Cement Treatment for Materials In Place
Item No. 230S	Rolling (Flat Wheel)
Item No. 232S	Rolling (Pneumatic Tire)
Item No. 234S	Rolling (Tamping)
Item No. 236S	Rolling (Proof)
Item No. 360S	Concrete Pavement
Item No. 402S	Controlled Low Strength Material
Item No. 404S	Pneumatically Placed Concrete
Item No. 405S	Concrete Admixtures
Item No. 411S	Surface Finishes for Concrete
Item No. 436S	P.C. Concrete Valley Gutters
Item No. 602S	Sodding for Erosion Control
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 642S	Silt Fence
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
432S-8A	Trash Receptacle Installation in Concrete Paver Sidewalk
432S-9A	Bench Installation in Concrete Paver Sidewalk
432S-10	Mailbox Placement Detail
433S-1	Type I Driveway (1 & 2 Family Residential Use Only)
433S-1A	Flared Type I Driveway (1 & 2 Family Residential Use Only)
433S-2	Type II Driveway
433S-3	Temporary Driveway
436S-2	Concrete Valley Gutter
470S-1	Curb Cut for Ramp or Driveway (Optional)
710S-3	Bicycle Rack Installation in Concrete Paver Sidewalks (Alternate 1)
1000-8(A)	Typical ROW and Front Lot Utility Assignments
1000-8(B)	Typical Single Service Utility Assignment Details (TV,W,WW)
1000S-10	Local Street Sections
1000S-11	Residential and Neighborhood Collector Street Sections
1000S-12	Primary Collector Street Sections
1000S-13	Minor Arterial Street Sections
1000S-14	Major Arterial Street Sections
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>

Item No. 100	Preparing Right of Way
Item No. 110	Excavation
Item No. 112	Subgrade Widening
Item No. 132	Embankment
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling
Item No. 210	Rolling (Flat Wheel)
Item No. 211	Rolling (Tamping)
Item No. 213	Rolling (Pneumatic Tire)

American Disabilities Act, Federal Register; Volume 56, No. 144; July 26, 1991 ADA Accessibility Guidelines For Building And Facilities

<u>Designation</u>	<u>Description</u>
Section 4.3	Accessible Route
Section 4.3.6	Surface Texture
Section 4.3.7 & 4.7.2	Slope
Section 4.3.8 & 4.5.2	Changes in Levels
Section 4.7	Curb Ramps
Section 4.8	Ramps

Architectural Barriers; Texas Civil Statutes, Article 9102; June 14, 1995 Texas Accessibility Standards (TAS)

<u>Designation</u>	<u>Description</u>
Section 4.3	Accessible Route
Section 4.3.6	Surface Texture
Section 4.3.7 & 4.7.2	Slope
Section 4.3.8 & 4.5.2	Changes in Levels
Section 4.7	Curb Ramps
Section 4.8	Ramps

ITEM NO. 433S P.C. CONCRETE DRIVEWAYS 12-9-08

433S.1 Description

This item shall govern construction of Portland Cement (p.c.) concrete driveways, as herein specified, on an approved subgrade, in conformity with the lines, grades and cross section indicated on the Drawings, identified in Standard Detail Series 433S, or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

433S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A and/or Item 360S p.c. concrete mix design,
- B. Type of Installation (i.e. Type I, Flared Type I, Type II, etc.) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane),
- C. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.

433S.3 Materials

A. Concrete

The Portland Cement Concrete for a Type I driveway (Standards 433S-1 and 433S—A) shall conform to Class A, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures." The Portland Cement Concrete for a Type II driveway (Standard 433S-2) shall conform to a normal concrete mix design for concrete pavement, Section 360S.5(A) of Standard Specification Item No. 360S, "Concrete Pavement".

B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

C. Expansion Joint Materials

Expansion joint materials shall conform to Standard Specification Item No. 408S, "Expansion Joint Materials."

D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing."

E. Cushion Layer

The Cushion layer shall consist of crusher screenings, gravel or coarse sand.

433S.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

A. Subgrade Preparation

The subgrade shall be excavated, prepared and shaped to the lines, grades and cross sections indicated on the Drawings or as directed by the Engineer or designated representative. The subgrade shall be thoroughly compacted in accordance with Standard Specification Item No. 201S, "Subgrade Preparation". A 2-inch (50-mm) minimum compacted thickness cushion shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the p.c. concrete is placed.

If the subgrade is undercut or natural ground is located below the top of subgrade, the necessary backfill material shall conform with Standard Specification Item 130S, "Borrow" and shall be compacted with a mechanical tamper. Hand tamping will not be permitted.

Where the subgrade material consists of gravel or includes 70 percent of rock, the 2-inch (50-mm) cushion layer may not be required. The Engineer or designated representative will determine if the subgrade meets the above requirements.

B. Forms

Forms shall be of metal, well-seasoned wood or other approved material of a section satisfactory to the Engineer or designated representative. Wood forms shall not be less than 2 inches (50 mm) nominal thickness for straight runs and 1-inch (25-mm) nominal thickness for curved runs. Forms shall be a section satisfactory to the Engineer or designated representative and clean, straight, free from warp and of a depth equal to the thickness of the finished work.

All forms shall be securely staked to line and grade and maintained in a true position during the placement of p.c. concrete.

C. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, $\frac{3}{4}$ inch (19 mm) thick, shall be provided where the new construction abuts the existing sidewalks or driveways or as directed by the Engineer or designated representative. The expansion joint material shall be placed vertically and shall extend the full depth of the p.c. concrete. Similar expansion material shall be placed around all obstructions protruding through the driveway. Weakened plane joints shall be located on 10-foot (3-meter) centers or as directed by the Engineer or designated representative. Normal dimensions of the weakened plane groove joints shall be $\frac{1}{4}$ -inch (6.25-mm) wide and $\frac{3}{4}$ -inch (19 mm) deep.

D. Reinforcement

Reinforcement for Type I driveways shall consist of 1 layer of 6 x 6 by W 1.4 x W 1.4 (150 x 150 by MW9 x MW9) wire fabric or No. 3 (10 M) bars placed not more than 18 inches (450 mm) on center, both directions. Reinforcement for Type II driveways shall consist of 1 layer of No. 4 (13 M) bars placed no more than 18 inches (450 mm) on center, both directions.

All reinforcements shall be accurately placed equidistant from the top and bottom of the p.c. concrete slab and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the steel at its proper position. In no instance shall the steel be placed directly on the subgrade or sand cushion layer.

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to ensure conformance with the drawings, specifications and this item. In addition, care shall be exercised to keep all steel in its proper position during the placement of p.c. concrete. If during placement of the concrete, the reinforcement is observed to lose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

Splices in wire fabric shall overlap sufficiently to allow two pairs of transverse wires to be tied together and no splice of less than 6 inches (150 mm) will be permitted. Splices in the No. 3 (10 M) and No. 4 (13 M) bars shall have a minimum lap of 12 inches (300 mm).

E. P.C. Concrete Placement and Finishing

The p.c. concrete shall be placed in the forms and spaced, tamped and thoroughly compacted until it entirely covers the surface and has a monolithic finish. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a broom or wood float to a gritty texture unless otherwise indicated on the Drawings. The outer edges and joints shall be rounded with approved tools to a ¼-inch (6.3 mm) radius. Care shall be exercised to prevent loss of dummy joints or rounded edges when applying the broom finish.

F. Curing

At the proper time after finishing, the surface shall be protected by a membrane compound curing agent in conformance with Standard Specification Item No. 409S, "Membrane Curing" or by wetting cotton or burlap mats. Either method shall be subject to approval by the Engineer or designated representative.

Traffic shall be barricaded from using the driveway for a minimum of 4 days after initial placing and may be opened to traffic only with approval of the Engineer or designated representative.

G. Incidental Work

All necessary excavation, filling and grading of the slopes, adjacent to the completed pcc driveways, will be considered incidental work pertaining to this item and will not be paid for directly.

The adjacent excavation and grading of the slopes shall be done with topsoil conforming to Standard Specification Item No. 130S, "Borrow". When turf is to be established, the preparation of the seedbed shall conform to Standard Specification Item No. 604S, "Seeding for Erosion Control", in a manner acceptable to the Engineer or designated representative.

433S.5 Measurement

Accepted work performed as prescribed by this item will be measured by the square foot (square meters: 1 square meter equals 10.764 square feet) of surface area of the specific type of p.c. concrete driveway.

433S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "Concrete Driveways." The unit bid price shall include full compensation for preparation of the subgrade; furnishing and placing all materials, including cushion layer, all reinforcing steel, bar supports and expansion joint materials; and any other materials, manipulations, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 433S-A:	Type I P.C. Concrete Driveway	Per Square Foot.
Pay Item No. 433S-B:	Flared Type I P.C. Concrete Driveway	Per Square Foot.
Pay Item No. 433S-C:	Type II P.C. Concrete Driveway	Per Square Foot.

End

SPECIFIC CROSS REFERENCE MATERIALS	
Specification Item No. 433S, "P.C. Concrete Driveways"	
City of Austin Standard Specifications	
Designation	Description
Item No. 130S	Borrow
Item No. 201S	Subgrade Preparation

Item No. 360	Concrete Pavement
Item No. 403S	Concrete for Structures
Section 403S.7; Item 403S	Table 4: Classes of Concrete
Item No. 406S	Reinforcing Steel
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures
Item No. 604S	Seeding for Erosion Control
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 433S-1	Type I Driveway (1 & 2 Family Residential Use Only)
No. 433S-1A	Flared Type I Driveway (1 & 2 Family Residential Use Only)
No. 433S-2	Type II Driveway

<u>RELATED CROSS REFERENCE MATERIALS</u>	
Specification Item No. 433S, "P.C. Concrete Driveways"	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 430S	P.C. Concrete Curb and Gutter
Item No. 431S	Machine Laid PCC Curb and Gutter
Item No. 432S	Concrete Sidewalks
Item No. 434S	P.C. Concrete Medians and Islands
Item No. 436S	P.C. Concrete Valley Gutters
Item No. 470S	Curb Cuts for Sidewalk Ramps and Driveways
Item No. 606S	Fertilizer

ITEM NO. 434S P.C. CONCRETE MEDIANS AND ISLANDS 11-13-07

434S.1 Description

This item shall govern construction of Portland cement concrete traffic islands and medians in accordance with these specifications and in conformity to the lines, grades, sections and details indicated on the Drawings or as established by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

434S.2 Submittals

The submittal requirements of this specification item include:

- A. Class A p.c. concrete mix design,
- B. Type of Installation (i.e. Median or Island) and construction details (i.e. cushion layer, base, reinforcing steel, joints, curing membrane).

434S.3 Materials

- A. Portland Cement (p.c.) Concrete

The p.c. concrete shall conform to Class A Concrete, Section 403S.7 (Table 4) of Standard Specification Item No. 403S, "Concrete for Structures".

- B. Reinforcing Steel

Reinforcing steel and welded wire fabric shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

- C. Expansion Joint Materials

Preformed expansion joint materials shall conform to Standard Specification Item No. 408S, "Expansion Joint Materials".

- D. Membrane Curing Compound

Membrane curing compound shall conform to Standard Specification Item No. 409S, "Membrane Curing".

- E. Admixtures

Admixtures shall conform to Standard Specification Item No. 405S, "Concrete Admixtures".

- F. Aggregate Cushion

Cushion layer shall consist of crusher screening, gravel, sand, crushed stone or "Flexible Base" materials (Standard Specification Item No. 210S) approved by the Engineer or designated representative.

434S.4 Construction Methods

All forms and forming, placement of reinforcement, placement of concrete, form removal, finishing and curing shall conform to Standard Specification Item No. 410S, "Concrete Structures".

A. PCC Mix Design

The p.c. concrete shall conform to an approved design mix for a Class A p.c. concrete on file with the City or proposed Class A mix designs with the necessary test data may be submitted for approval by the Engineer or designated representative.

High range water reducing admixtures conforming to Standard Specification Item No. 360, "Concrete Pavements" may be used when approved by the Engineer or designated representative.

B. Subgrade and Base Preparation

The subgrade shall be excavated, prepared and shaped to the lines, grades and cross section indicated on the Drawings or as directed by the Engineer or designated representative, and shall be thoroughly compacted conforming to Standard Specification Item No. 201S, "Subgrade Preparation". A cushion layer, 2 inches (50 mm) minimum thickness, shall be spread, wetted thoroughly, tamped and leveled. The cushion shall be moist at the time the p.c. concrete is placed.

C. Forms

Forms shall be of metal, well-seasoned wood or other approved material. The length of the forms shall be a minimum of 10 feet (3 meters). Flexible or curved forms shall be used for curves of 100-foot (30-meter) radius or less. Wood forms for straight sections shall be not less than 2 inches (50 mm) in thickness. Forms shall be a section, that is satisfactory to the Engineer or designated representative, and shall be clean, free from warp, and of a depth equal to the finished work. All forms shall be securely staked to line and grade and maintained in a true position during the placement of the p.c. concrete and, if required, forms shall be thoroughly oiled with a light form oil prior to p.c. concrete placement. If the adjacent existing asphalt pavement is damaged during construction, it shall be restored to its original condition.

D. Reinforcement

Reinforcement shall conform to the details indicated on the Drawings or the directions of the Engineer or designated representative. All reinforcement shall be accurately placed at slab mid-depth, equidistant from the top and bottom of the p.c. concrete, and held firmly in place by means of bar supports of adequate strength and number that will prevent displacement and keep the reinforcement in its proper position during the placement of the p.c. concrete. In no instance shall the steel be placed directly on the subgrade or sand cushion layer.

Prior to placement of the concrete, the reinforcement installation shall be inspected by the Engineer or designated representative to ensure conformance with the drawings, specifications and this item. In addition, care shall be exercised to keep all steel in its proper position during placement of the p.c. concrete. If during placement of the concrete, the reinforcement is observed to loose bar support, float upward or move in any direction, the placement shall be stopped until corrective action is taken.

E. Joints

Joints shall be of the type and spacing shown on the Drawings. Expansion joint material, $\frac{3}{4}$ inch (19 mm) in thickness, shall be placed as indicated on the Drawings with a maximum spacing of 40 feet (12 meters) or as directed by the Engineer or designated representative. Expansion joints shall be placed on the same alignment when adjacent to a Portland Cement concrete pavement. Weakened plane joints shall be made $\frac{3}{4}$ inch (19 mm) deep and equally spaced, normally at 5 foot (1.5 meters) on centers or as directed by the Engineer or designated representative. Expansion joints shall be required between the curb and median p.c. concrete.

F. P.C. Concrete Placement and Finishing

The p.c. concrete shall be placed in the forms to the depth indicated on the Drawings, and properly consolidated and until mortar entirely covers the surface and forms a monolithic finish. If a vibrator is used,

care shall be taken not to leave it in one location long enough to induce segregation. The top surface shall be floated and troweled to a uniform smooth surface, then finished with a camel hairbrush or wood float to a gritty texture. The outer edges shall be rounded with approved tools to the radii indicated on the Drawings.

When the ambient air temperature is above 85°F (30°C), an approved retarding agent will be required in all p.c. concrete. The maximum temperature of all p.c. concrete placed shall not exceed 95°F (35°C), unless High Range Water Reducer Admixtures are used.

G. Curing

Immediately after finishing the p.c. concrete median or island, the pcc surface shall be protected by a membrane-compound curing agent conforming with Standard Specification Item No. 409S, "Membrane Curing". The curing procedures shall be acceptable to the Engineer or designated representative.

434S.5 Measurement

Accepted work as prescribed by this item will be measured by the square foot (square meter: 1 square meter equals 10.764 square feet) of surface area of p.c concrete medians and/or p.c. concrete island, complete in place.

434S.6 Payment

The work performed as prescribed by this item will be paid for at the unit bid price per square foot for "P.C. Concrete Medians and Islands." The unit bid price shall include full compensation for preparation of the subgrade; finishing and placing all materials, including all reinforcing steel, welded wire fabric; bar supports and any other materials, manipulation, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under:

Pay Item No. 434S:	___ Inch P.C. Concrete Medians and Islands	Per Square Foot.
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End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Item No. 434S, "P.C. Concrete Medians and Islands"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 201S	Subgrade Preparation
Item No. 210S	Flexible Base
Item No. 403S	Concrete for Structures
Section 403S.7: Item No. 403S	Table 4: Classes of Concrete
Item No. 405S	Concrete Admixtures
Item No. 406S	Reinforcing Steel
Item No. 408S	Expansion Joint Materials
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification Item No. 434S, "P.C. Concrete Medians and Islands"</u>	

<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 360	Concrete Pavement
Item No. 430S	P.C. Concrete Curb and Gutter
Item No. 431S	Machine Laid PCC Curb and Gutter
Item No. 432S	P.C. Concrete Sidewalks
Item No. 433S	P. C. Concrete Driveways
Item No. 434S	P.C. Concrete Medians and Islands
Item No. 436S	P.C. Concrete Valley Gutters
Item No. 470S	Curb Cuts for Sidewalk Ramps and Driveways

ITEM NO. 503S FRAMES, GRATES, RINGS AND COVERS 2-17-00

503S.1 Description

This item shall govern furnishing and installation of frames, grates, rings and covers for inlets, manholes and other structures indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

503S.2 Submittals

The submittal requirements of this specification item include manufacturer, model number, description, painting requirements and characteristics of frames, grates, rings, covers, height adjustment insert and nuts and bolts required for completion of the work.

503S.3 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is the kind and quality that satisfies the specified functions and quality. The City of Austin Water and Wastewater Utility Standard Products Lists (SPLs) form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPLs; however, submittal to the Engineer or designated representative is still required. If the Contractor elects to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal.

The purpose of the SPLs is to expedite the review by the Engineer or designated representative and, if necessary, the City of Austin Water and Wastewater Utility Standard Products Committee of Contractor product submittals. The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items that are shown on the Drawings, called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the Engineer or designated representative in conjunction with the Water and Wastewater Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

A. Welded

Steel Welded steel grates and frames shall conform to the number; size, dimensions and details indicated on the Drawings and shall be welded into an assembly in accordance with those details. Steel shall conform to the requirements of ASTM A 36/A 36M, "Specification for Structural Steel".

B. Castings

Castings, whether Carbon-Steel, Gray Cast Iron or Ductile Iron shall conform to the shape and dimensions indicated on the Drawings and shall be clean substantial castings, free from sand or blowholes or other defects. Surfaces of the castings shall be free from burnt on sand and shall be reasonably smooth. Runners, risers, fins and other cast on pieces shall be removed from the castings and such areas ground smooth. Bearing surfaces between manhole rings and covers or grates and frames shall be cast or machined with such precision that uniform bearing shall be provided throughout the perimeter area of contact. Pairs of machined castings shall be matchmarked to facilitate subsequent identification at installation with the exception of water and wastewater manhole and valve castings. These manhole and valve castings shall be

fabricated with such draft, tolerances, bolt hole spacing, etc., that all rings and covers of a particular type or class are interchangeable and match-marking will not be required.

Steel castings shall conform to ASTM A 27/27M, "Specifications for Steel Castings, Carbon, for General Application". Grade 70-36 (480-250) shall be furnished unless otherwise specified on the Drawings.

Cast iron castings shall conform to ASTM A 48, "Specification for Gray Iron Castings", Class 30.

Ductile Iron castings shall conform to ASTM A 536, "Specification for Ductile Iron Castings". Grade 60-40-18 (415-275-125) shall be used unless otherwise indicated on the Drawings.

C. Manhole Cover Riser Rings

Height-adjustment inserts for wastewater manhole rings, which are used for raising standard manhole covers, shall be those models listed in Water and Wastewater Standard Products List item QPL WW-330.

D. Nuts and Bolts

Nuts and bolts shall be hex head $\frac{5}{8}$ " \times 2.5" (16 mm \times 63.5 mm) #11 National Coarse Thread, Type 316 stainless steel. For bolted manhole covers, a thin film of an approved "Anti-freeze" compound, approved by the Engineer or designated representative, shall be applied to all bolts.

E. Mortar

Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand and sufficient water to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for Grade No. 1, Item No. 403, "Concrete for Structures".

503S.4 Construction Methods

Frames, grates, rings and covers shall be constructed of the specified materials in accordance with the details indicated on the Drawings or in the City of Austin Standard Details. The Frames, grates, rings and covers shall be placed carefully to the lines or grades indicated on the Drawings or as directed by the Engineer or designated representative.

All welding shall conform to the requirements of the ANSI/AWS Structural Welding Code D1.1. Welded frames, grates, rings and covers shall be given 1 coat of a commercial grade red lead oil paint and 2 coats of commercial grade aluminum paint. All coats shall be a minimum of 1.5 mils (0.4 mm), dry.

Painting of gray iron castings will not be required, except when used in conjunction with structural steel shapes.

503S.5 Measurement and Payment

Frames, grates, rings and covers will not be measured and payment for furnishing all materials, tools, equipment, labor and incidentals to complete the Work will be included in the Bid Items which constitute the complete structures.

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Standard Specification Item Number 503S, "Frames, Grates, Rings and Covers"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 403S	Concrete for Structures

<u>City of Austin Water and Wastewater Standard Products List</u>	
<u>Designation</u>	<u>Description</u>
QPL-WW-330	Manhole Cover Riser Rings for raising City of Austin Standard Manhole Covers
<u>American Society for Testing Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
A36/A36M	Specification for Structural Steel
A27/A27M	Specification for Steel Castings, Carbon, for General Application
A48	Specification for Gray Iron Castings
A536	Specification for Ductile Iron Castings
<u>ANSI/AWS</u>	
<u>Designation</u>	<u>Description</u>
Code D 1.1	Structural Welding Code

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item Number 503S, "Frames, Grates, Rings and Covers"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 504S	Adjusting Structures
Item No. 510	Pipe
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 503S-1	457mm (18") Cover and Frame
No. 503S-2S	Storm Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-2W	Sanitary Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-3S	Bolted Storm Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-3W	Bolted Sanitary Sewer Manhole Ring and 610 mm (24") Cover
No. 503S-4S	Storm Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-4W	Sanitary Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-5S	Bolted Storm Sewer Manhole Ring and 813 mm (32") Cover
No. 503S-5W	Watertight Manhole Ring and 813 mm (32") Cover
No. 506S-2	Major Manhole Adjustment
No. 506S-11	Storm Sewer Manhole Details
<u>TxDOT Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item 421	Portland Cement Concrete

ITEM NO. 504S ADJUSTING STRUCTURES 2-24-10

504S.1 Description

This item shall govern the removal and replacement of surfacing, furnishing of materials, adjusting and/or repositioning existing structures, valve boxes, pull boxes, survey monument boxes and water meters in accordance with these specifications to the locations or elevations indicated on the Drawings or as directed by the Engineer or designated representative. This item shall also govern any pumping, bailing and drainage required to complete the Work and Standard Specification Item No. 509S, "Trench Safety Systems" for trench walls when indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text the inch-pound units are given preference followed by SI units shown within parentheses

504S.2 Submittals

The submittal requirements of this specification item include:

- A. Aggregate type, gradations and physical characteristics for the Portland cement concrete mix.
- B. Proposed proportioning of materials for the mortar mix.
- C. Type structures and proposed adjustment technique (lowering, raising, lateral displacement).
- D. Type structure, repair technique and materials to be furnished (new replacement or reuse of existing) Type of mixing plant and associated equipage including chart indicating the calibration of each cold bin

504S.3 Materials

Precast reinforced concrete rings and castings in good condition, which are removed from the structures to be adjusted, may be reused with the written approval of the Engineer or designated representative. Additional materials required shall conform to the details indicated on the Drawings.

- A. Portland Cement Concrete The Portland cement concrete shall be Class A conforming to Standard Specification Item No. 403, "Concrete for Structures".
- B. Mortar Unless otherwise specified or approved by the Engineer or designated representative, the mortar for bedding castings shall consist of one (1) part Portland cement and three (3) parts sand, by volume based on dry materials. Sufficient water will be added to provide the desired consistency. The gradation of the fine aggregate shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item No. 403, "Concrete for Structures".

504S.4 Construction Methods

All adjustments shall be completed prior to the placement of the final surface.

Pull box and valve box components scheduled for reuse shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at its own expense.

If the adjustment involves slight lowering or raising a valve box or survey monument box, the outside shell of a slip or screw casing shall be excavated to its full length and adjusted to the proposed grade. Pipe castings shall be

excavated to the depth required to cut from or weld a section to the casing as may be needed to adjust the ring to the proposed elevation. The ring shall be welded to the casing prior to pouring concrete around the casing.

If the adjustment involves a vertical (lowering or raising) or a horizontal reassignment of a water meter and the property owner's cut off valve, this work shall be completed in accordance with Standard Installation Details included in the City of Austin Standard Details Series (501S-1, 504S-3, 511S-13A, 511S-13B, etc.).

After the adjustments have been completed and cured, structures within the paved area shall be paved as indicated on the Drawings.

504S.5 Measurement

The work performed and materials furnished as prescribed by this item as indicated shall be measured per each.

504S.6 Payment

The work performed, materials furnished and measures as provided above, will be paid by the unit bid price per each. The price shall include full compensation for furnishing all materials, handling, placing, labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under one of the following:

Pay Item No. 504S-1WM:	Adjusting Water Meters	Per Each
Pay Item No. 504S-1RM:	Repositioning & Adjusting Water Meters	Per Each
Pay Item No. 504S-3G:	Adjusting Gas Valve Boxes to Grade	Per Each
Pay Item No. 504S-3S:	Adjusting Survey Monument Boxes to Grade	Per Each
Pay Item No. 504S-3W:	Adjusting Water Valve Boxes to Grade	Per Each
Pay Item No. 504S-4PB:	Adjusting Pull Boxes to Grade	Per Each

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 504S, "Adjusting Structures"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 403	Concrete for Structures
Item No. 509S	Trench Safety Systems
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 501S-1	Encasement Detail W/ Casing Spacers
No. 504S-3	Gas Valve Casing Adjustment
No. 511S-13A	Water Valve Box Adjustment to Grade w/ Full Depth Concrete
No. 511S-13B	Water Valve Box Adjustment to Grade w/ Concrete and HMA

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 504S, "Adjusting Structures"</u>	

<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 501S	Jacking or Boring
Item No. 503S	Frames, Grates, Rings and Covers
Item No. 505S	Concrete Encasement and Encasement Pipe
Item No. 507S	Bulkheads
Item No. 508S	Miscellaneous Structures and Appurtenances
Item No. 511S	Water Valves
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
No. 1100S-1	Casting Adjustment
No. 725S-1	Monument, Type A Survey Identification Marker
No. 725S-2	Monument, Type B Survey Identification Marker
No. 725S-3	Monument, Type C Survey Identification Marker
No. 725S-7	Survey Identification Marker Non-Traffic Construction Detail
No. 725S-10	Survey Identification Marker Roadway Construction Detail
No. 725S-11	Adjustable Valve Box For Survey Monument
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No.421	Portland Cement Concrete

ITEM NO. 506 MANHOLES 2-22-21

506.1 Description

This item governs construction of pre-cast and cast-in-place wastewater manholes, storm water manholes, storm water junction boxes and cast-in-place wastewater junction boxes, complete in place, including excavation, installation, backfilling and surface restoration; required items including rings, covers, coatings, and appurtenances; and incidental work such as pumping and drainage necessary to complete the work. Contractor-performed acceptance testing is required for wastewater manholes.

Source: Rule No. R161-21.08 , 2-22-2021.

506.2 Qualifications

Applicators of coatings to the interior surfaces of wastewater manholes, as specified in 506.4.R and 506.5.J, shall be listed on Austin Water (AW) Standard Products List (SPL) WW-511. Individual(s) setting up and operating equipment to core through the walls of existing manholes or junction boxes shall have experience in coring similar size holes through the walls of similar size and type structures on at least ten projects (or 15 manholes) in AW's jurisdiction.

Source: Rule No. R161-21.08 , 2-22-2021.

506.3 Project Submittals

A. Products and Materials

The Contractor shall submit descriptive information and evidence that the materials the Contractor proposes for incorporation in the Work are of the kind and quality that satisfy the requirements in the Contract Documents. AW shall be included in all submittal review. The AW SPLs are considered a part of the Specifications for the Work. The Contractor shall use products from the SPLs for all water and wastewater construction unless alternative products are shown on the Drawings; called for in the specifications; or specified in the Bidding Requirements, Contract Forms and Conditions of the Contract.

The products included in the SPLs current at the time of plan approval shall govern; unless a specific product or products on the lists have subsequently been removed from those SPLs because of quality or performance issues. Products and materials that are not covered by SPLs shall meet the requirements in the contract documents.

Submittals for the products and materials covered by this specification shall include manufacturer catalog sheets, technical data sheets, shop drawings, product or material test results, requirements listed below, and any other information needed to adequately describe the product or material. For products covered by SPLs, the submittal shall include a copy of the applicable SPL with the proposed product identified. An SPL by itself is not considered an adequate submittal.

The submittal requirements of this specification item include:

1. For pre-cast manholes and junction boxes: shop drawings for each structure showing, at a minimum, the Project and Contractor's name: manufacturer's name and plant location; applicable specifications; list of materials (such as adjusting rings, boots, gaskets, and pre-cast sections) by type and quantity; elevation view showing diameter or size, ring and cover size and elevation, ring type (bolted or unbolted, flared top or flared bottom) wall thickness, elevations of transitions from large diameter

sections to smaller diameter sections, base width and thickness, total depth, size of openings, reinforcement, and length of each pre-cast section; structure identification number and station location; pipe line identification; pipe material and size; pipe flowline elevations; plan view showing azimuthal orientation (based on 360 degrees clockwise) of the pipes relative to the outflow pipe; technical data sheets covering pipe-to-manhole or pipe-to-junction box connectors, and gaskets.

2. For cast-in-place manholes and junction boxes: formwork drawings sealed by a registered Professional Engineer licensed in the State of Texas with documented experience in formwork design for wall pours that exceed 4 feet in height and slabs that are not ground supported.
3. For hydraulic cement concrete; mix components and proportions, material sources, materials test results.
4. For mortar: mix components and proportions, material sources, materials test results.
5. For non-shrink grout: technical data sheet indicating ASTM type and containing instructions on surface preparation, mixing, placing, and curing procedures.
6. For wastewater manhole coatings and linings: technical data sheets that include instructions on surface preparation, mixing, placing, and curing procedures; technical data sheets for coating thickness measuring equipment and for holiday detection test equipment.
7. For connections to existing manholes or junction boxes: details showing the size, location, and method of removal of the wall section, including any temporary supports attached to the manhole or junction box wall; details showing the location of existing joints, other connecting pipes, and other features that penetrate or attach to the wall; and technical data sheets covering the pipe-to-manhole or pipe-to-junction box connectors.

B. Acceptance Test Records

Submittal of acceptance test records is required for wastewater manholes and shall include as a minimum the following items:

Name of the manhole manufacturer.

Interior surface coating type and application method.

Model and manufacturer of vacuum tester.

Date tested/date re-tested.

Indication of whether test passed or failed and statement of corrective action taken if test failed.

Test Method Used.

Location/station of manhole.

Type of base: Precast/cast-in-place.

Type of repairs made to the joints.

The test records shall also be included as part of the Project records turned in with the acceptance package.

C. Installation

The Contractor shall submit evidence that the individual(s) setting up the equipment and coring through the walls of manholes and junction boxes are experienced with the equipment and procedures and have successfully cored through the same types of materials using the same types of equipment.

Source: Rule No. R161-21.08 , 2-22-2021.

506.4 Materials

A. Concrete

All cast-in-place concrete shall conform to City of Austin (COA) Standard Specification Item No. 403S, "Concrete for Structures." Cast in place concrete shall be Class A or as specified on the Drawings. Concrete used in precast concrete manhole base sections, riser sections and appurtenances shall conform to the requirements of Texas Department of Transportation Item 421, Hydraulic Cement Concrete. Concrete for backfill of over-excavated areas shall be COA Class A, or Class J (COA Standard Specification Item 403S, Concrete For Structures) or Controlled Low Strength Material (COA Standard Specification Item 402S) as indicated on the Drawings.

B. Mortar

Mortar shall be composed of one part Portland cement, one part masonry cement (or ¼ part hydrated lime), and sand equal to 2½ to 3 times the sum of the volumes of the cements and lime used. The sand shall meet the requirements for "Fine Aggregate" as given in Standard Specification Item No. 403S "Concrete For Structures." Mortar shall not be used for any purpose on the inside of wastewater manholes.

C. Grout

Grout shall be the non-shrink type conforming to ASTM C 1107, Packaged, Dry, Hydraulic Cement Grout (Nonshrink), Grade C. Grout shall be used as packaged, with the mixed ingredients requiring only the addition of water.

D. Reinforcement

The reinforcing steel shall conform to the requirements of Standard Specification Item No. 406S, "Reinforcing Steel." Secondary, non-structural steel in cast-in-place stormwater manholes may be replaced by collated fibrillated polypropylene fibers, if approved by the Engineer or designated representative.

E. Brick

The brick for ring adjustment courses and for stormwater manholes shall be of first quality, sound, hard burned, perfectly shaped brick conforming to the requirements of ASTM C 62, Grade SW, or concrete brick meeting the requirements of ASTM C 55, Grade N-1. Use of brick to construct any part of wastewater manholes is prohibited.

F. Rings and Covers

Rings and covers shall conform to the requirements of COA Standard Specification Item No. 503, "Frames, Grates, Rings and Covers."

1. Replacement Rings and Covers, 24-inch Diameter Lids

This ring and cover shall be used for the replacement of broken rings and covers, minor manhole adjustment, or as otherwise directed by the Engineer or designated representative.

2. Rings and Covers, 32-inch Diameter Lids

This ring and cover shall be used for all new manhole construction, except as otherwise directed by the Engineer or designated representative.

G. Bulkheads

Bulkheads shall meet the requirements of COA Standard Specification Item No. 507 "Bulkheads."

H. Precast Base Sections, Riser Sections, Flat-top Slabs and Cones

Precast concrete base sections, riser sections, flat-top slabs, and cones shall conform to the requirements of ASTM C 478. The width of the invert shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped channels. The channel depth at the point where a pipe connects to the manhole wall, for pipes 24 inches in diameter and smaller, shall be a minimum of three-fourths of the diameter of the pipe, with the top of the channel being a smooth transition between the inlet and outlet pipe connection points. For manholes connecting to pipes larger than 24 inches in diameter, the channel depth at the point where a pipe connects to the manhole wall shall be at least equal to the full pipe diameter. Changes in flow direction in the inverts of manholes shall be made by constructing smooth, long-radius sweeps to minimize splashing, turbulence, and eddies. The manhole invert grade shall 1) be a continuation of the inlet and outlet pipe grades carried through to the centerline of the manhole, or 2) have a minimum slope of 2.5 percent between the inlet and outlet pipe inverts, or 3) have a minimum difference of 0.10 feet between the inlet and outlet pipe inverts, whichever provides the maximum difference in invert elevation between the inlet and outlet pipes, 4) have a straight section of invert that is 4 to 6 inches in length to transition between the curved portion of the invert channel and the connecting pipes in order to accommodate the mandrel apparatus for up to 15-inch diameter pipes. In all cases, the bottom(s) of the channel(s) shall provide a smooth transition between the inlet and outlet pipes. Where wastewater lines enter a manhole above the flowline of the outlet, the invert shall be filleted to prevent splashing and solids deposition.

Joints for wastewater base sections, riser sections, and cones shall conform to the requirements of ASTM C 443. Additionally, joint dimensions for 48-inch inside diameter wastewater manhole sections and cones shall comply with the "Wedge Seal Offset Joint Detail, Precast Manhole Section", located in SPL WW-146. Joint dimensions for wastewater manhole sections and cones larger than 48-inch inside diameter shall comply with COA Standard No. 506S-12, "O-Ring Joint Detail Precast Manhole Section" or "Wedge Seal Offset Joint Detail, Precast Manhole Section", located in SPL WW-146. Precast bases for 48-inch inside diameter manholes shall have preformed inverts. Inserts acceptable to the Engineer or designated representative shall be embedded in the concrete wall of the manhole sections to facilitate handling; however, through-wall holes for lifting will not be permitted.

I. Precast Junction Boxes

Precast junction boxes shall conform to the requirements of ASTM C913 and shall be allowed only where indicated on the Drawings or acceptable to the Engineer or designated representative.

J. Pipe-to-Manhole and Pipe-to-Junction-Box Connectors

Resilient connectors, ring waterstops, and seals at connections of wastewater pipes to pre-cast and cast-in-place manholes and junction boxes shall be watertight, flexible, resilient and non-corrosive, conforming to ASTM C 923. Metallic mechanical devices for securing the connectors, ring waterstops, and seals in place shall be Type 304 stainless steel.

K. Precast Flat-Slab Transition/Junction Box Lids

Precast slab transitions and lids shall be designed to safely resist pressures resulting from loads which might result from any combination of forces imposed by an HS-20 loading as defined by the American Association of State Highway and Transportation Officials (AASHTO). The joints of precast slab transitions and of lids for wastewater applications shall conform to the requirements of ASTM C443.

L. Precast-Prefabricated Tee Manholes

Tee manholes shall be allowed only where indicated on the Drawings or as directed by the Engineer or designated representative. The main pipe section shall conform to the requirements of COA Standard Specification Item No. 510, "Pipe." The vertical manhole portion (tee) above the main pipe shall conform to the requirements of the precast components.

The manhole tee shall have a minimum inside diameter of 48 inches and shall rise vertically centered or tangent to the main pipe, as indicated on the Drawings or as directed by the Engineer or designated

representative. An access hole less than 48 inches in diameter shall be cut into the main pipe to allow a ledge for support of access ladders. Unless otherwise specified on the Drawings, the main pipe portion of the tee manhole shall be included in the unit price bid for the unit tee manhole price.

M. Precast Grade Rings

Rings shall be reinforced Class A concrete

1. Precast Grade Rings, 24½ inches Inside Diameter

This adjustment ring shall be used only for adjusting existing manholes with 24-inch diameter lids and for Wastewater Access Device. Inside to outside diameter dimension of ring shall be 6 inches with a thickness of 3 to 6 inches.

2. Precast Grade Rings, 35 inches Inside Diameter

This adjustment ring shall be used for all new manhole construction with 32-inch diameter lids. Inside to outside diameter dimension of ring shall be 6 inches with a thickness of 2 to 6 inches.

N. High Density Polyethylene Grade Rings

Plastic grade (adjusting) rings shall be injection molded from high density polyethylene identified according to ASTM D4976. Reprocessable and recyclable ethylene plastic materials are allowed. Manufacturers of HDPE adjusting rings shall be listed on SPL WW-146G.

O. Controlled Low Strength Material

Controlled low strength material (CLSM) shall meet Standard Specification Item 402S, Controlled Low Strength Material.

P. Cement Stabilized Sand

Cement stabilized sand for bedding or backfilling shall contain 2 bags of Portland cement per cubic yard. The sand shall meet the requirements for "Fine Aggregate" in Standard Specification Item 403S, "Concrete for Structures."

Q. Waterproofing Joint Materials

O-rings and wedge seals for the joints of all wastewater manholes, and for stormwater manholes when indicated on the Drawings, shall conform to the requirements of ASTM C443. Cold applied preformed plastic gaskets for stormwater manholes shall be as specified in City of Austin Standard Specification Item No. 510, "Pipe." Plastic seals wrapped around manholes at joints, and hydrophilic waterstops installed in joints, shall be listed on SPL WW-146A. PVC waterstops installed in joints and waterproofing compounds applied to the exterior surfaces of manholes and junction boxes shall be as specified in the Contract Documents.

R. Interior Surface Coatings for Wastewater Manholes

Interior surface coatings for wastewater manholes shall be either: as specified on the Drawings, as designated in writing by the Engineer or designated representative, or as included on SPL WW-511, which lists acceptable products, uses and applicators.

S. Structural Lining Systems for Wastewater Manholes

Structural lining systems for wastewater manholes shall be either: as specified on the Drawings, as designated in writing by the Engineer or designated representative, or as included on SPL WW-511A.

Source: Rule No. R161-21.08 , 2-22-2021.

506.5 Construction

A. General

Pipe ends within the base section or junction box walls shall not be relied upon to support overlying manhole dead and live load weights. All wastewater branch connections to new or existing mains shall be made at manholes, with the branch pipe crown installed at an elevation no lower than the elevation of the effluent pipe crown. Changes in flow direction in the inverts shall be made by constructing smooth, long-radius sweeps to minimize splashing, turbulence, and eddies. Where wastewater lines enter the manhole up to 24 inches above the flowline of the outlet, the invert shall be sloped upward in a U-shaped channel three-fourths of the diameter of the incoming pipe to receive the flow, thus preventing splashing or solids deposition. A drop pipe shall be provided for a wastewater pipe entering a manhole whenever the invert cannot be constructed to prevent splashing and solids deposition. Construction of extensions to existing systems shall require placement of bulkheads at locations indicated or directed by the Engineer or designated representative.

Unless otherwise indicated on the Drawings, stormwater manholes shall have eccentric cones and wastewater manholes shall have concentric cones, except on manholes over large mains where an eccentric cone shall be situated to provide access to an invert ledge. Eccentric cones may be used where conflicts with other utilities dictate. Flat-slab tops may be used only where clearance problems are encountered or where specified on the Drawings. Cast-in-place wastewater junction boxes shall be allowed only where indicated on the Drawings or where accepted by the Engineer or designated representative.

B. Foundation Support

Manholes shall be founded at the established elevations on uniformly stable subgrade. Unstable subgrade shall be over-excavated a minimum of 12 inches and replaced with a material acceptable to the Engineer or designated representative. Precast base units shall be founded and leveled on a 6-inch thick layer of coarse aggregate bedding. A pipe section with a prefabricated tee manhole and half the length of the adjoining pipe sections on each side shall be founded on a minimum 6-inch thick layer of unreinforced Class A concrete (COA Standard Specification Item No. 403S, "Concrete For Structures"). The cast-in-place concrete cradle shall be placed against undisturbed trench walls up to the pipe's springline.

C. Cast-in-Place Concrete

Structural concrete work shall conform to Standard Specification Item No. 410S, "Concrete Structures." Forms shall be used for all slabs that are not ground supported and for all vertical surfaces above the foundation level. Formwork shall be designed according to American Concrete Institute ACI 347, Guide to Formwork for Concrete. Outside forms on vertical surfaces may be omitted where concrete can be cast against the surrounding earthen material that can be trimmed to a smooth vertical face.

D. Manhole Bases

Pre-cast bases shall conform to requirements in 506.4.H.

Cast-in-place bases shall have a minimum thickness of 12 inches at the invert flowline. The widths of all manhole inverts shall be specifically sized for the connecting pipes. Inverts shall be "U" shaped channels. The channel depth at the point where a pipe connects to the manhole wall, for pipes 24 inches in diameter and smaller, shall be a minimum of three-fourths of the pipe diameter, with the top of the channel being a smooth transition between the inlet and outlet pipe connection points. For manholes connecting to pipes greater than 24 inches in diameter, the channel depth at the point where a pipe connects to the manhole wall shall be equal to the full pipe diameter. The manhole invert grade shall 1) be a continuation of the inlet and outlet pipe grades carried through to the centerline of the manhole, or 2) have a minimum slope of 2.5 percent between the inlet and outlet pipe inverts, or 3) have a minimum difference of 0.10 feet between the

inlet and outlet pipe inverts, whichever provides the maximum difference in invert elevation between the inlet and outlet pipes, 4) have a straight section of invert that is 4 to 6 inches in length to transition between the curved portion of the invert channel and the connecting pipes in order to accommodate the mandrel apparatus for up to 15-inch diameter pipes. In all cases, the bottom(s) of the channel(s) shall provide a smooth transition between the inlet and outlet pipes. Changes in flow direction in the inverts of manholes shall be made by constructing smooth, large-radius sweeps to prevent splashing, turbulence, and eddies. The lowermost riser section may be set in the Portland cement concrete, while still plastic, after which the base shall be cured a minimum of 24 hours prior to proceeding with construction of the manhole up to 12 feet in depth. The base shall be cured an additional 24 hours prior to continuing construction above the 12-foot level.

Wastewater manholes having cast-in-place bases may be constructed over existing wastewater pipes and the top half of the pipe removed to facilitate invert construction, except where the existing pipe is PVC, in which case, the entire pipe shall be removed from inside the manhole. The manhole floor shall rise outwardly from the springline elevation of the pipe, approximately one inch for each 12 inches of run (8 percent slope). The floors of stormwater manholes, also, shall rise outwardly from the springline elevation of the pipe, approximately one inch for each 12 inches of run (8 percent slope).

Wastewater manholes with lines larger than 18 inches shall require pre-cast bases; manholes constructed over in-service mains however, may be built on cast-in-place bases if the flow cannot be interrupted.

E. Pipe Connections to New Manholes and Junction Boxes

Wastewater pipe connections to new manholes and junction boxes shall be made using flexible, resilient, and non-corrosive watertight boot connectors or ring waterstops acceptable to the Engineer and conforming to the requirements of ASTM C-923. Any voids in the annular space between the pipe and boot connector or ring waterstop and the inside of the manhole wall shall be filled with non-shrink grout to prevent solids collection. New precast manholes and manholes with cast-in-place bases shall have holes for pipe penetrations in the manhole wall separated by a minimum of 7 inches, designed by the manhole manufacturer and as measured from the inside diameter of the cored or formed holes on the inside wall of the manhole to ensure the structural integrity of the manhole wall.

F. Pipe Connections to Existing Manholes and Junction Boxes

Wastewater pipe connections to existing manholes and junction boxes shall be made by removing the wall section by coring; installing flexible, resilient, and non-corrosive boot connectors or ring waterstops acceptable to the Engineer and conforming to the requirements of ASTM C-923; filling any voids in the annular space between the pipe and boot connector or ring waterstop and the inside of the manhole or junction box wall with non-shrink grout; rebuilding the invert to conform to Section 506.5.D; rehabilitating the interior walls with structural lining material listed on SPL WW-511A, and coating the interior of the manhole with material listed on SPL WW-511. Connections to existing manholes and junction boxes shall be made at locations that allow the removal limits of the wall section to be no closer than 12 inches to the inside diameter of the nearest existing connecting pipe. Equipment used to remove the wall section shall be operated in a manner that does not damage the adjacent interior coating, substrate, or wall. This includes installation of anchors or other supports that are attached to the manhole or junction box wall for temporary support of the removal equipment.

G. Waterproofing

PVC waterstops, hydrophilic waterstops, joint wrapping, and waterproofing compounds shall be installed as specified. Material wrapped around manholes at joints shall be listed on SPL WW-146A regardless of whether installation of the material is required by the Contract for waterproofing or is volunteered by the Contractor for ensuring acceptance of the manhole joints.

H. Backfilling

Backfilling of manholes shall conform to the density requirements of COA Standard Specification Item No. 510, "Pipe." Manhole construction in roadways may be staged to facilitate pavement base construction. Manholes constructed to interim elevations to facilitate interim construction shall be covered with steel plates that conform to the requirements of COA Standard 804S-4, sheets 5, 6 and 7, Steel Plating. Steel plates on wastewater manholes shall be set in mortar to minimize inflow of storm water runoff. Manholes shall be completed to finish elevation prior to placement of the roadway's finish surface except on pavement reconstruction projects, where castings may be adjusted after paving is completed. The excavation for completion of manhole construction shall be backfilled in accordance with COA Standards for Trench Repair.

I. Height Adjustment of Manholes

1. General

All adjustments shall be completed prior to the placement of the final roadway surface except on pavement reconstruction projects, where castings may be adjusted after paving is completed.

Brick shall not be used in making height adjustments to wastewater manholes. Mortar shall not be used for any purpose on the inside of wastewater manholes.

Manhole components to be reused shall be carefully removed and the contact areas shall be cleaned of all mortar, concrete, grease and sealing compounds. Any items broken in the process of removal and cleaning shall be replaced in kind by the Contractor at its expense.

If the adjustment involves lowering the top of a manhole, a sufficient depth of pre-cast concrete rings or brick courses shall be removed to permit reconstruction. Existing mortar shall be cleaned from the top surface remaining in place and from all brick or concrete rings to be reused and the manhole rebuilt to the required elevation. The manhole ring and cover shall then be installed with the top surface conforming to the proposed grade.

If the adjustment involves raising the elevation of the top of the manhole in accordance with "Minor Manhole Height Adjustment," the top of brick or concrete ring shall be cleaned and built up vertically to the new elevation, using new or salvaged concrete rings or bricks and the ring and cover installed with the top surface conforming to the proposed grade.

After rings and covers are set to grade, the inside and outside of the precast concrete grade rings shall be wiped with non-shrink grout to form a durable surface and water-tight joints. The grouted surface shall be smooth and even with the manhole cone section. Grout shall not be placed when the atmospheric temperature is at or below 40°F. If a sudden drop in temperature below 40°F occurs or temperatures below 40°F are predicted, the grouted surfaces shall be protected against freezing for at least 24 hours.

2. Minor Manhole Height Adjustment (New and Existing Manholes)

Minor manhole height adjustments shall be performed as indicated on COA Standard 506S-4, "Minor Manhole Height Adjustment", and shall consist of adding precast reinforced concrete rings to adjust new and existing manholes to final grade. Brick shall not be used in making height adjustments to wastewater manholes.

If the adjustment involves raising the elevation of the top of the manhole, the top of brick or concrete ring shall be cleaned and built up vertically to the new elevation, using new or salvaged concrete rings or bricks and the ring and cover installed with the top surface conforming to the proposed grade.

For new manhole construction, the maximum allowable throat or chimney height, including the depth of the ring casting, shall be limited to 21 inches of vertical face on the interior surface. For adjustments of existing manholes that fall within the limits of overlay and street reconstruction projects, the maximum vertical allowable height, including the depth of the ring casting, shall be limited to 27 inches of vertical face on the interior surface. All other existing manholes shall have a maximum allowable

throat or chimney height adjustment, including the depth of the ring casting, of 12 inches of vertical face on the interior surface. Any adjustment that will exceed these requirements shall be accomplished as indicated on COA Standard 506S-2, "Major Manhole Height Adjustment" and as described below. Manholes not located in paved areas shall have bolted covers. Manholes located within paved areas (street right-of-way only) shall be standard non-bolted unless otherwise noted on the drawings.

3. Major Manhole Height Adjustment (Existing Manholes Only)

Any adjustment that exceeds the requirements of Minor Manhole Adjustments, shall be accomplished as indicated on COA Standard 506S-2, "Major Manhole Height Adjustment," and shall consist of any combination of removing and replacing the concrete rings, and/or the manhole cone section, and/or the straight riser section of the manhole in order to bring the manhole to final grade. Major manhole adjustments shall apply only to existing manholes. Manholes not located in paved areas shall have bolted covers. Manholes located within paved areas (street right-of-way only) shall be standard non-bolted unless otherwise noted on the drawings.

J. Interior Coatings of Wastewater Manholes and Junction Boxes

The interior surfaces of all Portland cement concrete wastewater manholes and junction boxes shall be coated with products specified either on the Drawings, designated in writing by the Engineer or representative, or listed on SPL WW-511. Product selection shall conform to usage described in that SPL. Surface preparation shall follow the product manufacturer's recommended procedures contained in technical data sheets unless otherwise specified in the contract documents. The Contractor shall measure the coating thickness according to ASTM D 6132, Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Over Concrete Using an Ultrasonic Gage. Thickness measures shall be made at locations designated by the Engineer or designated representative. All thickness measurements shall be witnessed by the Engineer or designated representative.

The contractor shall test for discontinuities (holidays) in each new layer of interior organic coating applied to wastewater manholes and junction boxes. The test methods and equipment shall confirm to ASTM D4787, Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrate. Each new layer of applied coating shall be tested to detect pinholes, voids, cracks, thin spots, and foreign inclusions. All discontinuity testing shall be performed using high-voltage, pulse-type equipment and witnessed by the Engineer or designated representative. The test voltage shall depend on the coating thickness according to the tabulated values in ASTM D4787. Test voltages for common coating thicknesses are as follow:

Coating or Lining Thickness, Mils	Test Voltage
20	2700
40	5500
80	11500
120	16500

K. Structural Linings of Existing Wastewater Manholes

The interior surfaces of existing wastewater manholes and junction boxes at locations shown in the Drawings or as designated by the Engineer shall be strengthened by application of structural lining systems either as specified on the Drawings, directed in writing by the Engineer or designated representative, or listed on SPL WW-511A. Selection of products for coating the interior of existing manholes shall be based on the condition of the manholes. Surface preparation shall follow the product manufacturer's recommended procedures contained in technical data sheets unless otherwise specified in the contract documents.

L. Abandonment of Existing Manholes

Manholes designated on the Drawings for abandonment, shall be removed to a level not less than four feet below grade. Two-foot long sections of the inlet and outlet pipes shall be cut and removed on the outside of the manhole, the ends of the remaining pipe and the pipe sections penetrating the manhole wall shall be securely plugged, and the structure filled with material in accordance with COA Standard 506S-15 or as directed by the Engineer or designated representative.

Source: Rule No. R161-21.08 , 2-22-2021.

506.6 Acceptance Testing of Wastewater Manholes

Manholes shall be tested separately and independently of the wastewater lines.

A. Test by the Vacuum Method

A vacuum test shall be performed by the Contractor prior to backfilling those manholes that fall within the right-of-way that require detouring of vehicular traffic. A second vacuum test will not be required after backfilling and compaction is complete unless there is evidence that the manhole has been damaged or disturbed subsequent to the initial vacuum test.

For manhole installations which do not require detouring of vehicular traffic, the vacuum method is recommended and may be used by the Contractor prior to backfilling the manhole to insure proper installation so that defects may be located and repaired; however, a vacuum test shall be performed after backfilling, and compaction are complete. Testing after backfill and compaction are complete will be the basis for acceptance of the manhole.

1. Equipment

- a) The manhole vacuum tester shall be a device approved for use by the Engineer or designated representative.
- b) Pipe sealing plugs shall have a load resisting capacity equal to or greater than that required for the size of the connected pipe to be sealed.
- c) Gauges shall be calibrated and read in inches of mercury (inches Hg or in Hg) or pounds per square inch gauge (psig) or both.

2. Procedures applicable to new 48-inch diameter manholes

- a) Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before installation or unless it is applied at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints. Tests shall be performed before grouting the invert or around pipe penetrations and before coating the interior surfaces of the manhole or junction box.
- b) After cleaning the interior surfaces of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer. Plugs and the ends of pipes connected by flexible boots shall be blocked to prevent their movement during the vacuum test.
- c) The vacuum test head shall be placed on the top of the cone section or, inside of the top of the manhole cone section, and the compression seal band inflated to the pressure recommended by its manufacturer. The vacuum pump shall be connected to the outlet port with the valve open. When a vacuum of 10 inches of mercury (-10" Hg) (-5 psig) has been attained, the valve shall be closed and the time noted. Tampering with the test equipment will not be allowed.

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- d) The manhole shall have passed the test if the vacuum does not drop below 9 inches of mercury (-9" Hg) (-4.5 psig) within 3 minutes of the time the valve was closed. The actual vacuum shall be recorded at the end of the 3 minutes during which the valve was closed.
 - e) When the standard vacuum test cannot be performed because of design or material constraints (examples: T-Type manholes, T-Lock Liners, or other reasons acceptable to the Engineer or designated representative), testing of individual joints shall be performed as directed by the Engineer or designated representative.

B. Test by the Exfiltration Method

At the discretion of the Engineer or designated representative, the Contractor may substitute the Exfiltration Method of testing for the Vacuum test described in Section 506.6.A. above. This method may only be used when ground water is not present. If ground water is present a Vacuum Test shall be used unless otherwise directed by the Engineer or designated representative. All backfilling and compaction shall be completed prior to the commencement of testing.

The procedures for the test shall include the following:

1. Manhole section interiors shall be carefully inspected; units found to have through-wall lift holes, or any penetration of the interior surface by inserts provided to facilitate handling, will not be accepted. Coating shall be applied after the testing unless coating is applied before field assembly, or at the factory. All lift holes and exterior joints shall be plugged with an acceptable non-shrink grout. No grout shall be placed in horizontal joints. Tests shall be performed before grouting the invert or around pipe penetrations and before coating the interior surfaces of the manhole or junction box.
2. After cleaning the interior surface of the manhole, the Contractor shall place and inflate pneumatic plugs in all of the connecting pipes to isolate the manhole; sealing pressure within the plugs shall be as recommended by the plug manufacturer.
3. Concrete manholes shall be filled with water or otherwise thoroughly wetted for a period of 24 hours prior to testing.
4. At the start of the test, the manhole shall be filled to the top with water. The test time shall be 1 hour. The Construction Inspector must be present for observation during the entire time of the test. Permissible loss of water in the 1-hour test time is 0.025 gallons per diameter foot, per foot of manhole depth. For a 4-foot diameter manhole, this quantity converts to a maximum permissible drop in the water level (from the top of the manhole cone) of 0.1 inches per foot of manhole depth or 1.0 inch for a 10-foot deep manhole.

C. Failure to Pass the Test - Records of Tests

If the manhole fails to pass the initial test method as described in (A) Test by the Vacuum Method and, if allowed, (B) Test by the Exfiltration Method, or if visible groundwater leakage into the manhole is observed, the Contractor shall locate the leak, if necessary by disassembly of the manhole. The Contractor shall check the gaskets and replace them if necessary. The Contractor may re-lubricate the joints and re-assemble the manhole, or the Contractor may install an acceptable exterior joint sealing product (see AW Standard Products List Item SPL WW-146A) on all joints and then retest the manhole. If any manhole fails the vacuum and/or exfiltration test twice, the Contractor shall consider replacing that manhole. If the Contractor chooses to attempt to repair that manhole, the manhole must be retested until it passes. In no case shall cold applied preformed plastic gaskets be used for repair. Records of all manhole testing shall be made available to the Engineer or designated representative at the close of each working day, or as otherwise directed by the Engineer or designated representative. Any damaged or visually defective products, or any products out of acceptable tolerance shall be removed from the site.

D. Inspection

The Engineer or designated representative shall make a visual inspection of each manhole after it has passed the testing requirements and is considered to be in its final condition. The inspection shall determine the completeness of the manhole; any defects shall be corrected to the satisfaction of Engineer or designated representative.

Source: Rule No. R161-21.08 , 2-22-2021.

506.7 Measurement

A "Junction Box" and "Box Manholes" will be measured by each structure of the indicated size regardless of depth.

A "Standard Pre-cast Manhole with Pre-cast Base", "Standard Pre-cast Manhole with Cast-in-Place (CIP) Base", "Special Manhole", "Drop Manhole with Pre-cast Base", "Drop Manhole with Cast-in-Place (CIP) Base", "Centered Tee Manhole", or "Tangent Tee Manhole" will be measured by each structure of the indicated size for the first 8 feet of depth.

An "Extra Depth Manhole" will be measured by linear vertical foot of Standard Pre-cast Manhole with Pre-cast Base, Standard Pre-cast Manhole with CIP Base, Drop Manhole with Pre-cast Base, Drop Manhole with CIP Base, Special Manhole, Centered Tee Manhole, or Tangent Tee Manhole of the indicated size in excess of eight feet of depth. Manhole depth will be measured from the invert flow line to the finished surface elevation.

"Minor Manhole Height Adjustment" and "Major Manhole Height Adjustment" will be measured by each unit for the indicated size. Only existing manholes will be measured for minor or major manhole height adjustment.

"Connection to Existing Manhole or Junction Box" will be measured per each for the indicated type of structure and location.

"Structural Lining" will be measured by the linear vertical foot for the indicated structure.

New manholes constructed to interim elevations to facilitate stage construction shall be measured as one unit regardless of the number of interim elevations constructed. All labor, materials and other expenses necessary for the stage construction shall be included in the unit price bid for the completed unit. Cost of abandonment of existing manholes shall be included in the unit price bid for the completed unit, unless Pay Item No. 506 AB is indicated on the Drawings and identified in Standard Contract Bid Form 00300U.

Source: Rule No. R161-21.08 , 2-22-2021.

506.8 Payment

Payment for completed junction boxes and manholes of the type indicated on the Drawings shall be made at the appropriate unit bid price. The unit bid price shall include all labor, equipment, materials, (including but not limited to frames and grates, rings and covers, adjusting rings, cone sections, riser sections, gaskets, drop piping and fittings, bases, pipe-to-manhole connectors, concrete, reinforcing steel, non-shrink grout, mortar, joint wrap where specified, and, for wastewater manholes, interior coatings), time and incidentals necessary to complete the work.

Payment for a "Junction Box" and "Box Manhole" will be made at the unit price bid for the indicated size, complete in place.

Payment for the first 8 feet of a "Standard Pre-cast Manhole with Pre-cast Base", "Standard Pre-cast Manhole with Cast-in-Place (CIP) Base", "Special Manhole", "Drop Manhole with Pre-cast Base", "Drop Manhole with Cast-in-Place (CIP) Base", "Centered Tee Manhole", or "Tangent Tee Manhole" will be made at the unit price bid for the indicated type and size, complete in place.

Payment for that portion of a Standard Pre-cast Manhole with Pre-cast Base, Standard Pre-cast Manhole with CIP Base, Drop Manhole with Pre-cast Base, Drop Manhole with CIP Base, Special Manhole, Centered Tee Manhole, or

Tangent Tee Manhole in excess of 8 feet in depth will be made at the unit price bid for "Extra Depth Manhole" of the indicated type and size, complete in place.

Payment for "Minor Manhole Height Adjustment" and "Major Manhole Height Adjustment" will be made at the unit bid price, complete in place.

Payment for "Structural Lining" will be made at the unit price per linear vertical foot, which will include surface preparation, environmental adjustments, lining application, and curing, as required.

Payment for "Connection to Existing Manhole or Junction Box" shall be made at the unit price per connection and will include removing the wall section by coring or alternative method approved by the Engineer or designated representative, rehabilitating the interior walls, rebuilding the invert, and preparing and coating the interior surfaces of the structure.

When indicated in the Drawings, abandonment of existing manholes shall be made at the unit price for abandonment.

The intended use of each item shall be designated by a two-letter code (Wastewater = WW; Stormwater = SW) in the spaces provided after the pay item number:

Pay Item No. 506 M __:	Standard Pre-cast Manhole w/Pre-cast Base, ___ Dia.	Per Each.
Pay Item No. 506 M1 __:	Standard Pre-Cast Manhole w/CIP Base, ___ Dia.	Per Each.
Pay Item No. 506 S __:	Special Manhole, ___ Dia.	Per Each.
Pay Item No. 506 D __:	Drop Manhole w/Pre-cast Base, ___ Dia.	Per Each.
Pay Item No. 506 D1 __:	Drop Manhole w/CIP Base, ___ Dia.	Per Each.
Pay Item No. 506 C __:	Centered Tee Manhole, ___ Dia. x ___ Dia.	Per Each.
Pay Item No. 506 T __:	Tangent Tee Manhole, ___ Dia. x ___ Dia.	Per Each.
Pay Item No. 506 J __:	Junction Box, ___ Ft. x ___ Ft.	Per Each.
Pay Item No. 506 B __:	Box Manhole ___ Ft. x ___ Ft.	Per Each.
Pay Item No. 506 2 __:	Major Manhole Height Adjustment, ___ Dia.	Per Each.
Pay Item No. 506 4 __:	Minor Manhole Height Adjustment, ___ Dia.	Per Each.
Pay Item No. 506 AB __:	Abandonment of existing Manholes:	Per Each.
Pay Item No. 506 EDM __:	Extra Depth of Manhole, ___ Dia.	Per Linear Vert. Foot.
Pay Item No. 506 SL __:	Structural Lining of ___:	Per Linear Vert. Foot.
Pay Item No. 506 CN __:	Connection to Existing ___:	Per Each.

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Standard Specification Item No. 506, "Manholes"</u>	
<u>COA Standard Specifications Items</u>	
<u>Designation</u>	<u>Description</u>
Item 402S	Controlled Low Strength Material
Item 403S	Concrete For Structures
Item 406S	Reinforcing Steel
Item 410S	Concrete Structures
Item 503	Frames, Grates, Rings and Covers
Item 504	Adjusting Structures
Item 507	Bulkheads
Item 510	Pipe
<u>Texas Department of Transportation Standard Specifications For Construction and Maintenance of Highways, Streets and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item 421	Hydraulic Cement Concrete
<u>COA Utilities Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 2.8.0	Abandonment of Facilities
Subsection 2.9.4.D	Manholes
<u>AW Standard Products Lists</u>	
<u>Designation</u>	<u>Description</u>
SPL WW-146	Concrete Manhole Sections
SPL WW-146A	Manhole Seals
SPL WW-146G	Manhole Grade Rings, Plastic
SPL WW-511	Organic Lining for Wastewater Manholes
SPL WW-511A	Structural Lining for Wastewater Manholes
<u>COA Standard Details</u>	
<u>Designation</u>	<u>Description</u>
506S-2	Major Manhole Height Adjustment
506S-4	Minor Manhole Height Adjustment
506S-15	Abandoned Manhole
506S-12	O-Ring Joint Detail, Precast Manhole Section
506S-15	Abandoned Manhole
804S-4, 5, 6 and 7 of 9	Steel Plating
<u>COA Standard Contract</u>	
<u>Designation</u>	<u>Description</u>
00300U	Bid Form (Unit Prices)
<u>American Society for Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>

ASTM C 55	Specification for Concrete Building Brick
<u>Designation</u>	<u>Description</u>
ASTM C 62	Specification for Building Brick Solid Masonry Units Made from Clay of Shale
ASTM C478/C478M	Standard Specification for Precast Concrete Manhole
ASTM C443/C443M	Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C923/C923M	Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures Pipes
ASTM C1107	Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM D4787	Continuity Verification of Liquid or Sheet Lining Applied to Concrete Substrate
ASTM D4976	Specification for Polyethylene Plastics Molding and Extrusion Materials
ASTM D6132	Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coating Over Concrete Using an Ultrasonic Gage
<u>American Concrete Institute</u>	
<u>Designation</u>	<u>Description</u>
Item 347	Guide to Formwork for Concrete

RELATED CROSS REFERENCE MATERIALS	
<u>Standard Specification Item No. 506, "Manholes"</u>	
AW Standard Products Lists	
SPL WW-219	32 Inch Manhole Cover Casting Sets
COA Utilities Criteria Manual	
<u>Designation</u>	<u>Description</u>
Section 2	Water, Reclaimed Water and Wastewater Criteria
COA Standards	
<u>Designation</u>	<u>Description</u>
1100S-1	Casting Adjustments
503S-4S	Storm Sewer Manhole Ring and 32" Cover
503S-5S	Bolted Storm Sewer Manhole Ring and 32" Cover
506S-1	Manhole Invert Plan
506S-5	Typical Box Manhole 30" and Larger Pipe
506S-7	Precast Manhole with Drop Inlet on Cast in Place Foundation
506S-8	Precast Manhole with Drop Inlet on Precast Base
506S-9	Precast Manhole on Cast-In-Place Foundation
506S-10	Wastewater Manhole on Precast Base
506S-11	Storm Sewer Manhole Details
<u>American Association of State Highway and Transportation Officials (AASHTO)</u>	
<u>Designation</u>	<u>Description</u>
M306	Standard Specifications for Drainage Structure Castings

Source: Rule No. R161-21.08 , 2-22-2021.

ITEM NO. 509S EXCAVATION SAFETY SYSTEMS 9-26-12

509S.1 Description

This item shall govern the designing, furnishing, installing, maintaining and removing or abandoning of temporary Excavation Safety Systems consisting of trench shields, aluminum hydraulic shoring, timber shoring, trench jacks, tied-back or braced sheeting, tied-back slurry walls, soil nailing, rock bolting, tied-back or braced soldier piles and lagging, and other systems for protecting workers in excavations. This item shall also govern the designing and constructing of sloping and benching systems for protecting workers in excavations.

At a minimum, the Excavation Safety Systems shall conform to United States Department of Labor Rules 29 CFR, Occupational Safety and Health Administration, Part 1926 Safety and Health Regulations for Construction, Subpart P, Excavation (hereinafter called OSHA).

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

509S.2 Definitions

COMPETENT PERSON shall mean one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. The **COMPETENT PERSON** shall be capable of interpreting the manufacturer's data sheets and interpreting and implementing the Excavation Safety System Plan.

An **EXCAVATION** shall mean any cut, cavity, trench, or depression in an earth surface, formed by earth removed by the Contractor. The Contractor shall provide an Excavation Safety System for all excavations except when 1) the excavation is in stable rock as determined by the Texas-licensed Professional Engineer who prepared the Contractor's Excavation Safety System Plan or 2) the excavation is less than 5 feet (1.52 m) in depth and examination of the ground by the Contractor's competent person provides no indication of a potential cave-in.

TRENCH (TRENCH EXCAVATION) shall mean any narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth shall be greater than the width, but the trench (measured at the bottom) shall not be wider than 15 feet (4.56 m). Excavation Safety Systems for such trenches shall be defined as Trench Excavation Safety Protective Systems.

If the Contractor installs or constructs forms or other structures in an excavation such that the dimension measured from the forms or structures to the sides of the excavation is reduced to 15 feet (4.6 m) or less (measured at the bottom of the excavation), those excavations shall also be defined as a **TRENCH** if workers must enter it. Excavation Safety Systems for such **TRENCHES** shall also be defined as **TRENCH EXCAVATION SAFETY PROTECTIVE SYSTEMS**.

509S.3 Excavation Safety System Plan Submittal

- A. The Notice to Proceed with construction may be issued by the Owner before the Contractor has submitted the necessary Excavation Safety Plan(s); however, excavation shall not proceed until the Owner has received the Contractor's Excavation Safety Plan(s) for the Project.
- B. Prior to Starting Excavation
Prior to starting any Excavation, the Contractor shall submit to the Owner:

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1. A certificate indicating that the Contractor's Competent Person(s) has completed training in an excavation safety program based on OSHA regulations within the past 5 years.
 2. Manufacturer's tabulated data or other tabulated data for Excavation Safety Systems consisting of pre-engineered protective systems such as trench shields, aluminum hydraulic shoring, timber shoring, pneumatic shoring, or trench jacks, or benching or sloping or other protective systems that are not designed specifically for the Project.

Manufacturer's tabulated data shall meet the requirements in OSHA and shall describe the specific equipment to be used on the Project. Tabulated data must bear the seal of the licensed professional engineer who approved the data. Manufacturer's tabulated data shall be an attachment to the Contractor's Excavation Safety System Plan described below.

509S.4 Excavation Safety System Plan Review

The Contractor shall prepare an Excavation Safety System Plan (hereafter called the "Plan") specifically for the Project. The Contractor shall retain a Texas-licensed Professional Engineer to prepare the Plan. On City-funded projects, the Contractor must follow qualifications-based procedures to procure the required Professional Engineering services, according to Chapter 2254 of the Texas Government Code.

The Contractor shall be responsible for obtaining geotechnical information necessary for design of the Excavation Safety System. If geotechnical information for design of the Project has been acquired by the Owner or designated representative, it shall be provided to the Contractor for information purposes subject to the provisions of City of Austin Standard Contract Section 00220, "Geotechnical Data."

- A. The Plan for Excavation Safety Systems consisting of pre-engineered protective systems such as trench shields, aluminum hydraulic shoring, timber shoring, pneumatic shoring, or trench jacks, or benching or sloping or other protective systems that are not designed specifically for the Project shall include:
 1. Detailed Drawings of the Excavation Safety System(s) that will provide worker protection conforming to OSHA. The Drawings shall note the required load carrying capacity, dimensions, materials, and other physical properties or characteristics in sufficient detail to describe thoroughly and completely the Excavation Safety System(s).
 2. Drawings, notes, or tables clearly detailing the specific areas of the Project in which each Excavation Safety System shall be used, the permissible size of the excavation, the length of time that the excavation shall remain open, the means of egress from the excavation, the location of material storage sites in relation to the excavation, the methods for placing/compacting bedding/backfill within the safety of the system, any excavation safety equipment restrictions and subsequent removal of the system.
 3. Recommendations and limitations for using the Excavation Safety Systems.
 4. A Certificate of Insurance of the Excavation Safety System Engineer's Professional Liability Insurance coverage. For City-funded projects, coverage meeting the requirements of Standard Contract Documents Section 00810 shall be provided. For privately funded projects the coverage shall be at least \$1,000,000.
- B. The Plan for Excavation Safety Systems consisting of tied-back or braced sheeting, tied-back or braced soldier piles and lagging, slurry walls, soil nailing, rock bolting or other protective systems that are designed specifically for the Project shall include:
 1. Detailed Drawings of the Excavation Safety System(s) that will provide worker protection conforming to OSHA. The Drawings shall note the design assumptions, design criteria, factors of safety, applicable

codes, dimensions, components, types of materials, and other physical properties or characteristics in sufficient detail to describe thoroughly and completely the Excavation Safety System(s).

2. Detailed technical specifications for the Excavation Safety System addressing the properties of the materials, construction means and methods, quality control and quality assurance testing, performance monitoring, and monitoring of adjacent features, as appropriate.
3. Drawings that clearly detail the specific areas of the Project in which each type of system shall be used and showing the Special Shoring in plan and elevation (vertical profile) views.
4. Drawings, notes or tables clearly detailing the length of time that the excavation shall remain open, the means of egress from the excavation, the location of material storage sites in relation to the excavation, the methods for placing/compacting bedding/backfill within the safety of the system, any excavation safety equipment restrictions and subsequent removal or abandonment of the system or parts thereof.
5. Recommendations and limitations for using the Excavation Safety Systems.
6. A Certificate of Insurance of the Excavation Safety System Engineer's Professional Liability Insurance coverage. For City-funded projects, coverage meeting the requirements of Standard Contract Documents Section 00810 shall be provided. For privately funded projects the coverage shall be at least \$1,000,000.

509S.5 Excavation Safety System Submittal Review

Review of the Excavation Safety System submittal conducted by the Owner or designated representative shall only relate to conformance with the requirements herein. The Owner's failure to note exceptions to the submittal shall not relieve the Contractor of any or all responsibility or liability for the adequacy of the Excavation Safety System. The Contractor shall remain solely and completely responsible for all Excavation Safety Systems and for the associated means, methods, procedures, and materials.

509S.6 Contractor's Responsibility

The Contractor shall be responsible for implementing the Excavation Safety System Plan and for confirming that the Excavation Safety System(s) used on the Project meets the requirements of the Plan.

The Contractor's Competent Person(s) shall be on the Project whenever workers are in an excavation meeting the definitions of a Trench given in 509S.2.

509S.7 Construction Methods

The Contractor's Competent Person(s) shall maintain a copy of appropriate OSHA regulations on-site and shall implement OSHA excavation safety regulations at the work site. The Contractor shall perform all excavation in a safe manner and shall maintain the Excavation Safety Systems to prevent death or injury to personnel or damage to structures, utilities or property in or near excavation.

If evidence of possible cave-ins or earthen slides is apparent or an installed Excavation Safety System is damaged, the Contractor shall immediately cease work in the excavation, evacuate personnel from any potentially hazardous areas and notify the Owner. Personnel shall not be allowed to re-enter the excavation until necessary repairs or replacements are completed and are inspected and approved by the Contractor's Competent Person(s). Repair and replacement of damaged Excavation Safety System shall be at the Contractor's sole expense.

509S.8 Changed Conditions

When changed conditions require modifications to the Excavation Safety System, the Contractor shall provide to the Owner or designated representative a new design or an alternate Excavation Safety System Plan that is proposed by the Contractor's Excavation Safety System Engineer to address the changed conditions. Copies of the new design or alternate system shall be provided to the Owner or designated representative in accordance with the requirements of section 509S.3, "Excavation Safety System Plan Submittals." A copy of the most current Excavation Safety System Plan shall be maintained on site and made available to inspection and enforcement officials at all times.

Any changes to the Excavation Safety System Plan that are initiated by the Contractor for operational efficiency or as a result of changed conditions, that could be reasonably anticipated, will not be cause for contract time extension or cost adjustment. When changes to the Excavation Safety System Plan are necessitated by severe and uncharacteristic natural conditions or other conditions not reasonably within the control of the Contractor, the Contractor may make a written request to the Owner for a Change Order to address the anticipated work. The Contractor shall notify the Owner in writing within 24 hours of the occurrence of changed conditions that the Contractor anticipates the submittal of a claim for additional compensation. Under "Changed Conditions" the work deemed immediately necessary by the Contractor to protect the safety of workers and public, equipment or materials may only be accomplished until the Owner or designated representative has a reasonable opportunity to investigate the Contractor's written request for a Change Order and respond in writing to the request.

509S.9 Measurement

Trench Excavation Safety Protective Systems will only be measured and paid for those trenches that workers would reasonably be expected to enter.

Trench Excavation Safety Protective Systems for Trenches excavated to a final width (measured at the bottom of the excavation) not exceeding 15 feet (4.56 m) shall be measured by the linear foot (meter: 1 meter equals 3.281 feet) through manholes, bore pits, receiving pits, and other appurtenances along the centerline of the trench. This method of measurement shall apply to any and all protective systems, including but not limited to tieback or braced sheeting, tieback or braced soldier piles and lagging, slurry walls, soil nails, rock bolts, shoring, trench boxes, and sloping or benching as used to provide a Trench Excavation Safety Protective System in accordance with the Excavation Safety System Plan.

Trench Excavation Safety Protective Systems for Trenches created by installation or construction of forms or other structures in an excavation whose width is greater than 15 feet (4.56 m) such that the dimension measured from the forms or structures to the sides of the excavation is reduced to 15 feet (4.56 m) or less (measured at the bottom of the excavation) shall be measured by the linear foot along the centerline of the Trench. Where forms or structures create multiple Trenches in one excavation, each Trench shall be measured separately. This method of measurement shall apply to any and all protective systems, including but not limited to tieback or braced sheeting, tieback or braced soldier piles and lagging, slurry walls, soil nails, rock bolts, shoring, trench boxes, and sloping or benching as used to provide a Trench Excavation Safety Protective System in accordance with the Excavation Safety System Plan.

509S.10 Payment

Payment for Trench Excavation Safety Protective Systems, measured as prescribed above, will be made at unit bid price per centerline linear foot of Trench. The unit bid price shall include full compensation for designing, furnishing, installing the system; for dewatering, and for maintaining, replacing, repairing and removing the Trench Excavation Safety Protective System and for sloping, special clearing, and excavation necessary to safely implement the Excavation Safety System Plan. No payment will be made for Trench Excavation Safety Protective

Systems made necessary by the Contractor's selection of an optional design or sequence of work that creates the need for the Trench Excavation Safety Protective System

Payment will be made under the following:

Pay Item No. 509S-1:	Trench Excavation Safety Protective Systems (all depths)	Per Linear Foot.
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END

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item No. 509S, "Excavation Safety Systems"</u>	
City of Austin Standard Contract Documents	
<u>Designation</u>	<u>Description</u>
Section 00020	Invitation for Bids
Section 00220	Geotechnical Data
Section 00650	Certificate of Insurance
Section 00700, Article 6.11	Safety and Protection
Section 810	Supplemental General Conditions
29 CFR, Occupational Safety and Health Administration, Part 1926 Safety and Health Regulations for Construction, Subpart P, Excavation	
Texas Health and Safety Code Title 9 Chapter 756 Subchapter C	
Texas Government Code Chapter 2254	

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Standard Specification Item No. 509S, "Excavation Safety Systems"</u>	
Texas Department of Transportation: Standard Specifications For Construction and Maintenance of Highways, Streets, and Bridges	
<u>Designation</u>	<u>Description</u>
Item 104	Removing Concrete
Item 110	Excavation
Item 402	Trench Excavation Protection
City of Austin Standard Specification Items	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right of Way
Item No. 102S	Clearing and Grubbing
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 130S	Borrow
Item No. 132S	Embankment
Item No. 201S	Subgrade Preparation
Item No. 402S	Controlled Low Strength Material
Item No. 501S	Jacking or Boring Pipe

Item No. 503S	Frames, Grates, Rings and Covers
Item No. 504S	Adjusting Structures
Item No. 505S	Concrete Encasement and Encasement Pipe
Item No. 506	Manholes
Item No. 507S	Bulkheads
Item No. 510	Pipe
Item No. 511S	Water Valves
Item No. 593S	Concrete Retards
Item No. 594S	Gabions and Revet Mattresses

ITEM NO. 510 PIPE 12-8-18**510.1 Description**

This item governs the furnishing and installing all pipe and/or materials for constructing pipe mains, sewers, laterals, stubs, inlet leads, service connections, culverts, temporary service lines and temporary diversion lines, including all applicable Work such as excavating, bedding, jointing, backfilling materials, tests, concrete trench cap, concrete cap and encasement, etc., prescribed under this item in accordance with the provisions of the Edwards Aquifer Protection Ordinance, when applicable, and City of Austin Utility Criteria Manual, Section 5, "Working in Public Rights-of-Way." The pipe shall be of the sizes, types, class and dimensions indicated or as designated by the E/A and shall include all joints or connections to new or existing mains, pipes, sewers, manholes, inlets, structures, etc., as may be required to complete the Work in accordance with specifications and published standard practices of the trade associations for the material specified and to the lines and grades indicated. This item shall include any pumping, bailing, and drainage when indicated or applicable. Unless otherwise provided, this item shall consist of the removal and disposition of trees, stumps and other obstructions, old structures or portions thereof such as house foundations, old sewers, masonry or concrete walls, the plugging of the ends of abandoned piped utilities cut and left in place and the restoration of existing utilities damaged in the process of excavation, cutting and restoration of pavement and base courses, the furnishing and placing of select bedding, backfilling and cement or lime stabilized backfill, the hauling and disposition of surplus materials, bridging of trenches and other provisions for maintenance of traffic or access as indicated.

510.2 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation into the Work are of the kind and quality that satisfies the specified functions and quality. Austin Water Utility Standard Products Lists (SPL) form a part of the Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the E/A is still required. Should the Contractor elect to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal. This will expedite the review process in which the E/A, and, if necessary, the Austin Water Utility Standard Products Committee, decides whether the products meet the Contract requirements and the specific use foreseen by the E/A in the design of this engineered Project. The purpose of the SPL's is to expedite review, by the E/A and, if necessary, the Austin Water Utility Standard Products Committee, of Contractor product submittals. The SPL's shall not be considered as being a pre-approved list of products necessarily meeting the requirements of the Project. Items contained in the SPL cannot be substituted for items shown on the Drawings, or called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the E/A in conjunction with the Austin Water Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

(1) Concrete

Concrete shall conform to Item No. 403S, "Concrete for Structures".

(2) Coarse Aggregate

Coarse aggregate shall conform to Item No. 403S, "Concrete for Structures" or one of the following:

(a) Pipe Bedding Stone

Pipe bedding stone shall be clean gravel, crushed gravel or crushed limestone, free of mud, clay, vegetation or other debris, conforming to ASTM C 33 for stone quality. Size gradation shall conform to ASTM C-33 No. 57 or No. 67 or the following Table:

SIEVE SIZE	% RETAINED BY WEIGHT
1½"	0
1"	0—10
½'	40—85
#4	90—100
#8	95—100

(b) Foundation Rock

Foundation rock shall be well graded coarse aggregate ranging in size from 2 to 8 inches.

(c) Flexible Base

Flexible base shall conform to Item No. 210S, "Flexible Base".

(3) Fine Aggregate

(a) Concrete and Mortar Sand

Fine aggregate shall conform to Item No. 403S, "Concrete for Structures".

(b) Bedding Sand

Sand for use as pipe bedding shall be clean, granular and homogeneous material composed mainly of mineral matter, free of mud, silt, clay lumps or clods, vegetation or debris. The material removed by decantation TxDOT Test Method Tex-406-A, plus the weight of any clay lumps, shall not exceed 4.5 percent by weight.

The resistivity shall not be less than 3000 ohms-cm as determined by TxDOT Test Method Tex-129-E. Size gradation of sand for bedding shall be as follows:

GRADATION TABLE	
SIEVE SIZE	% RETAINED BY WEIGHT
¼"	0
#60	75—100
#100	95—100

(c) Stone Screenings

Stone screenings shall be free of mud, clay, vegetation or other debris, and shall conform to the following Table:

SIEVE SIZE	% PASSING
¾"	100
No. 4	95 to 100
No. 8	80 to 100
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

All screenings shall be the result of a rock crushing operation.

(4) Controlled Low Strength Material

Controlled Low Strength Material (CLSM) shall conform to Item 402S, "Controlled Low Strength Material.

(5) Pea Gravel

Pea gravel bedding shall be clean washed material, hard and insoluble in water, free of mud, clay, silt, vegetation or other debris. Stone quality shall meet ASTM C 33. Size gradation shall be as follows:

SIEVE SIZE	% RETAINED BY WEIGHT
¾"	0
½"	0—25
¼"	90—100

(6) Select Backfill or Borrow

This material shall consist of borrow or suitable material excavated from the trench. It shall be free of stones or rocks over 8 inches and shall have a plasticity index of less than 20. The moisture content at the time of compaction shall be within 2 percent of optimum as determined by TxDOT Test Method Tex-114-E. Sandy loam borrow will not be allowed unless shown on the Drawings or authorized by the E/A.

All suitable materials from excavation operations not required for backfilling the trench may be placed in embankments, if applicable. All unsuitable materials that cannot be made suitable shall be considered surplus excavated materials as described in 510.3(13). The Contractor may, if approved by the engineer, modify unsuitable materials to make them suitable for use. Modification may include drying, removal or crushing of over-size material, and lime or cement treatment.

(7) Cement Stabilized Backfill

When indicated or directed by the E/A, all backfill shall be with cement-stabilized backfill rather than the usual materials. Unless otherwise indicated, cement stabilized backfill material shall consist of a mixture of the dry constituents described for Class J Concrete. The cement and aggregates shall be thoroughly dry mixed with no water added to the mixture except as may be directed by the E/A.

(8) Pipe

General

Fire line leads and fire hydrant leads shall be ductile iron. Domestic water services shall not be supplied from fire service leads, unless the domestic and fire connections are on separately valved branches with an approved backflow prevention device in the fire service branch. All wastewater force mains shall be constructed of ductile iron pipe Pressure Class 250 minimum for pipe greater than 12-inch size and Pressure Class 350 for pipe 12-inch size and smaller. Wastewater pipe shall be in accordance with Austin Water Utility's Standard Products List SPL WW-534 and shall have a corrosion resistant interior lining acceptable to the Owner.

All water pipe within utility easements on private property shall be Ductile Iron Pipe, Pressure Class 350 minimum for pipe 12-inch size and smaller and Pressure Class 250 minimum for pipe greater than 12-inch size wrapped as indicated. For sizes over 24 inches, Concrete Pressure Pipe, steel cylinder type, conforming to the requirements of AWWA C-301 will be acceptable.

There may be no service connections to Concrete Pressure Pipe installed in utility easements on private property. Approved service clamps or saddles shall be used when tapping ductile iron pipe 12 inch size

and smaller. All service tubing (¾ inch thru 2 inches) installed in utility easements on private property shall be 150 psi annealed seamless Type K copper tubing with no sweat or soldered joints.

All reclaimed water mains shall be constructed of ductile iron pipe, Pressure Class 350 minimum for pipe 12-inch size and smaller and pressure class 250 for pipe greater than 12-inch size. For mains 12-inch size and smaller, PVC pipe, conforming to the requirements of AWWA C-900, DR 14 shall be acceptable. Reclaimed water pipe shall be manufactured purple, painted purple, or wrapped in purple polyethylene film wrap.

Manufacturers of concrete pipe and pipe larger than 24-inch diameter shall have a quality control program consisting of one or more of the following: 1) a quality management system certified by the American National Standards Institute (ANSI) or National Sanitation Foundation (NSF) to comply with ISO 9001:2000, 2) a quality management system certified by the QCast Program following the requirements of the ACPA Plant Certification Manual, 3) a quality management system certified by the National Precast Concrete Association 4) a quality control program approved by the OWNER prior to submittal of bids for the PROJECT, or 5) an independent, third party quality control testing and inspection firm for testing and inspecting pipe produced for the PROJECT and approved by the OWNER prior to submittal of bids for the PROJECT. All such quality control programs shall be paid for by the manufacturer. It is the intent of this requirement that the manufacturer will document all appropriate tests and inspections with sampling and inspection criteria, frequency of testing and inspection, date of testing and inspection and date on which every piece was manufactured. Required testing and inspection, including that by an independent, third party, shall be performed full-time during production of pipe for the PROJECT. When requested by the OWNER, the manufacturer will provide copies of test data and results and inspection reports with the shipment of pipe for the PROJECT. Test data and results and inspection reports shall be traceable to specific pipe lots or pieces. Owner approval of the manufacturer's quality control program will expire after three years, at which time the manufacturer must present a current quality control program for approval in order to retain listing on the applicable SPL. Owner approval of the Concrete Pipe manufacturer's quality control program will expire after three years, at which time the manufacturer must present a current quality control program for approval.

The quality of materials, the process of manufacture and the finished pipe shall be subject to inspection and approval by the E/A at the pipe manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the City Representative. Only manufacturers having a quality control program of the type described above will be considered as approved providers of concrete pipe and pipe products as listed in the Standard Products List (SPL).

All water distribution pipe and fittings shall be listed in the Fire Protection Equipment Directory published by the Underwriter's Laboratories, Inc., or shall be Factory Mutual approved for fire service. All water pipe and related products shall be registered by the National Sanitation Foundation as having been certified to meet NSF/ANSI Standard 61.

- (a) Reserved
- (b) Iron Pipe

Iron pipe shall be ductile iron pipe meeting all requirements of standards as follows:

-For push-on and mechanical joint pipe: AWWA C-151

-For flanged pipe: AWWA C-115

Barrels shall have a nominal thickness required by Table 1 of AWWA C-115, which thickness corresponds to Special Class 53 in sizes through 54 inch, and Class 350 in 60 and 64-inch sizes. Flanges shall be ductile iron (gray iron is not acceptable); they shall be as shown in ANSI/AWWA C115/A21.15 and shall conform to dimensions shown in Table 2 and Figure 1

of AWWA C115. These flanges are the same in all respects as flanges shown in ANSI/AWWA C110/A21.10 for fittings and are standard for all flanges used with pipe, valve, and equipment units in the City of Austin water distribution and wastewater force main systems. Flanges shall be fabricated and attached to the pipe barrels by U.S. fabricators using flanges and pipe barrels of U.S. manufacture. If fabrication is to be by other than the pipe barrel manufacturer, a complete product submittal and approval by the Austin Water Utility will be required. Additionally, such fabricator shall furnish certification that each fabricated joint has been satisfactorily tested hydrostatically at a minimum pressure of 300 psi.

-Linings and Coating:

Interior surfaces of all iron potable or reclaimed water pipe shall be cement-mortar lined and seal coated as required by AWWA C104. Interior surfaces of all iron wastewater line and force main pipe shall be coated with a non-corrosive lining material as indicated on Austin Water Utility's Standard Products List SPL WW-534. Pipe exteriors shall be coated as required by the applicable pipe specification. The type and brand of interior lining shall be clearly marked on the outside of the pipe and fittings. Except as authorized by the E/A, only one type and brand of pipe lining shall be used on a given project.

Except as described above for flanged pipe (Thickness Class 53) and where not otherwise indicated, ductile iron pipe shall be minimum Class 250 as defined by ANSI/AWWA C150/A21.50-current; all ductile iron pipe and flanges shall meet the following minimum physical requirements:

Grade 60-42-10:

- Minimum tensile strength: 60,000 psi (414 mPa).
- Minimum yield strength: 42,000 psi (290 mPa).
- Minimum elongation: 10 percent.

The flanges for AWWA C115 pipe may be also be made from:

Grade 70-50-05:

- Minimum tensile strength: 70,000 psi (483 mPa).
- Minimum yield strength: 50,000 psi (345 mPa).
- Minimum elongation: 5 percent.

1. Ductile Iron Fittings:

Fittings shall be push-on, flanged or mechanical joint as indicated or approved and shall meet all requirements of standards as follows:

- Sizes 4 inch through 24 inch: AWWA C-110 or AWWA C-153
- Sizes larger than 24 inch: AWWA C-110.

-Lining and Coating:

Interior surfaces of all iron potable/reclaimed water pipe fittings shall be lined with cement-mortar and seal coated as required by AWWA C104.

Interior surfaces of all iron wastewater and force main fittings shall be coated with a non-corrosive lining material acceptable to Owner. Fitting exteriors shall be coated as required by the applicable pipe specification.

2. Joint Materials

Gaskets for mechanical joints shall conform to ANSI/AWWA A21.11/C-111.

Joining of slip joint iron pipe shall, without exception, be accomplished with the natural or synthetic rubber gaskets of the manufacturer of that particular pipe being used. A joint lubricant shall be used and applicable recommendations of the manufacturer shall be followed.

Gaskets for flanged joints shall be continuous full face gaskets, of 1/8 inch minimum thickness of natural or synthetic rubber, cloth-reinforced rubber or neoprene material, preferably of deformed cross section design and shall meet all applicable requirements of ANSI/AWWA A21.11/C-111 for gaskets. They shall be manufactured by, or satisfy all recommendations of, the manufacturer of the pipe/fittings being used and be fabricated for use with Class 125 ANSI B16.1 flanges.

Tee-head bolts, nuts and washers for mechanical joints shall be high strength, low alloy, corrosion resistant steel stock equal to "COR-TEN A" having UNC Class 2 rolled threads or alloyed ductile iron conforming to ASTM A 536; either shall be fabricated in accordance with ANSI/AWWA A21.11/C-111.

Hex head bolts and nuts shall satisfy the chemical and mechanical requirements of ASTM A449 SAE Grade 5 plain, and shall be fabricated in accordance with ASTM B 18.2 with UNC Class 2 rolled threads.

Either Tee-Head or Hex-Head bolts, nuts and washers as required, shall be protected with bonded fluoro-polymer corrosion resistant coating where specifically required by the E/A.

All threaded fasteners shall be marked with a readily visible symbol cast, forged or stamped on each nut and bolt, which will identify the fastener material and grade. The producer and the supplier shall provide adequate literature to facilitate such identification; painted markings are not acceptable.

3. Polyethylene Film Wrap

All iron pipe, fittings and accessories shall be wrapped with standard 8 mil (minimum) low density polyethylene film or 4-mil (minimum) cross laminated high-density polyethylene conforming to AWWA C-105, with all edges overlapped and taped securely with duct tape to provide a continuous wrap to prevent contact between the piping and the surrounding backfill. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling. Polyethylene film wrap for reclaimed water pipe shall be purple.

4. Marking

Each pipe joint and fitting shall be marked as required by the applicable AWWA specification. This includes in all cases: Manufacturer's identification, Country where cast, year of casting, and "DUCTILE" or "DI". Barrels of flanged pipe shall show thickness class; others shall show pressure class. The flanges of pipe sections shall be stamped with the fabricators identification; fittings shall show pressure rating, the nominal diameter of openings and the number of degrees for bends. Painted markings are not acceptable.

5. Warning Tape

Warning tape for identifying restrained joint pipe and fittings shall be yellow and shall have black lettering at least 2 inches high that reads "Restrained Joint / Junta de Restriccion" at intervals not exceeding 24 inches. The warning tape shall be polypropylene having a minimum thickness of 2 mils, a minimum width of 3 inches, and adhesive backing on the side opposite the lettering.

(c) Concrete

1. General

Pipe shall conform to ASTM C 76 for Circular Pipe. Concrete pipe smaller than 12 inches in diameter shall conform to ASTM C 14, Extra Strength. All pipe shall be machine made or cast by a process which will provide uniform placement of the concrete in the form and compaction by mechanical devices, which will assure a dense concrete. Concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the concrete can be assured. Transit mixed concrete shall not be acceptable for use in precast pipe. The pipe shall be Class III or the class indicated. Storm sewer pipe shall be of the tongue and groove or O-ring joint design. Wastewater pipe shall be of the O-ring joint design; it shall be acceptably lined for corrosion protection.

2. Marking

Each joint of pipe shall be marked with the pipe class, the date of manufacture, the manufacturer's name or trade mark, diameter of pipe and orientation, if required.

Pipe marking shall be waterproof and conform to ASTM C 76.

3. Minimum Age for Shipment

Pipe shall be considered ready for shipment when it conforms to the tests specified in ASTM C 76.

4. Joint Materials

When installing storm sewers (or storm drains), the Contractor shall have the option of using joints with preformed flexible joint sealants or with rubber gaskets. Preformed flexible joint sealants for storm drain joints shall comply with ASTM C990, and rubber gaskets for storm drain joints shall comply with ASTM C 1619. Mortar shall not be used to seal pre-fabricated joints. Pipe manufacturer shall be responsible for submitting to the Owner a detailed design of the joint upon request. The pipe manufacturer shall be responsible for submitting to the Owner a complete list of joint sizes showing the minimum size of material to be used with each size joint, along with complete instructions on recommended installation procedures. Quality control testing at the manufacturing plant shall be in accordance with Texas Department of Transportation (TxDOT) Departmental Materials Specifications (DMS) 7310, "Reinforced Concrete Pipe And Machine-Made Precast Concrete Box Culvert Fabrication And Plant Qualification". The pipe manufacturer shall be verified as compliant with TxDOT DMS 7310 at time of pipe delivery to the jobsite.

a. Mortar

Mortar for joints shall meet the requirements set forth below in "Mortar".

b. Cold Applied Preformed Plastic Gaskets

Cold Applied Plastic Gaskets shall be suitable for sealing joints of tongue and groove concrete pipe. The gasket sealing the joint shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross section. The size of the plastic gasket joint sealer shall be in accordance with the manufacturer's recommendations and sufficient to obtain squeeze-out around the joint. The gasket joint sealer shall be protected by a suitable removable wrapper that

may be removed longitudinally without disturbing the joint sealer to facilitate application.

The chemical composition of the gasket joint sealing compound as shipped shall meet the following requirements:

Composition (% by weight)	Test Method	Typical Analysis
Bitumen (petroleum plastic content)	ASTM D 4	50-70
Ash-inert Mineral Water	Tex-526-C	30-50
Volatile Matter (at 325 F)	Tex-506-C	2.0 Maximum

The gasket joint sealing compound when immersed for 30 days at ambient room temperature separately in 5 percent solution of caustic potash, a mixture of 5 percent hydrochloric acid, a 5 percent solution of sulfuric acid and a saturated H2S solution shall show no visible deterioration.

The physical properties of the gasket joint sealing compound as shipped shall meet the following requirements:

Property	Test Method	Typical Analysis	
		Minimum	Maximum
Specific Gravity at 77 F	ASTM D 71	1.20	1.35
Ductility at 77F (cm) Minimum	Tex-503-C	5.0	
Softening point	Tex-505-C	275 F	
Penetration:			
32 F (300 g) 60 sec	Tex-502-C	75	
77 F (150 g) 5 sec	Tex-502-C	50	120
115 F (150 g) 5 sec	Tex-502-C		150
Flashpoint C.O.C. F	Tex-504-C	600 F	
Fire Point C.O.C. F	Tex-504-C	625 F	

When constructing wastewater lines, the Contractor shall use O-ring gasket joints conforming to ASTM C 443. Just before making a joint, the ends of the pipe shall be clean, dry, free of blisters or foreign matter and shall be wire brushed. For O-ring joints, the gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound to facilitate assembly of the joint. The rubber O-ring gasket shall be stretched uniformly in the joint. Wedge seal type ("Forsheda" pre-lubricated) gaskets may be used if joint details submitted are approved; installation of such gaskets shall be in strict accordance with the manufacturer's recommendations, and shall be the sole element depended upon to make the joint flexible and watertight.

In wastewater lines no horizontal or vertical angles in the alignment of pipes shall be permitted unless indicated. The spigot shall be centered in the bell, the pipe pushed uniformly home and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint.

5. Bends

When horizontal or vertical angles in the alignment of storm sewers are indicated, the bend or angle shall be constructed by cutting on a bias one or both pipes as may be required for the alignment indicated. The pipe cut shall be sufficiently long to allow exposing the reinforcement, which shall be bent, welded and incorporated into the pipe bend and reinforced concrete collar to maintain the structural integrity. The collar shall be 6 inches minimum, reinforced with #4 bars on a 1 foot center both directions. Builder's hardware cloth may be used on the outside of the joint to aid in holding cementing materials in place. Plywood, fiberboard or other materials placed on the inside of the pipe as formwork shall be removed as soon as the joint materials have obtained initial set, after which the inside surface of the pipe joint shall be finished smooth and true to the line and grade established. The Contractor may use prefabricated bends meeting the specification requirements in lieu of field fabricated bends. All bends shall be watertight, have a smooth flow line and be equal or greater in strength to the adjacent pipe.

Horizontal or vertical changes in alignment in wastewater lines shall be accomplished by use of manholes. With the E/A's approval, horizontal changes in alignment may be made by the "Joint Deflection" method. Joint deflection is limited by regulations of the Texas Commission on Environmental Quality (TCEQ) to 80 percent of the maximum recommended by the manufacturer; such deflection may not exceed 5 degrees at any joint. Changes in alignment using pipe flexure shall not be allowed.

6. Sulfide and Corrosion Control

All concrete pipe used for wastewater installations shall be protected from sulfide and corrosion damage by using limestone aggregate.

(d) Concrete Steel Cylinder (CSC) Pipe

1. General Requirements

The Contractor shall submit to the E/A for approval along with other required data a tabulated layout schedule with reference to the stationing and grade lines to be used.

The manufacturer shall furnish all fittings and special pieces required for closures, bends, branches, manholes, air valves, blow offs and connections to main line valves and other fittings as indicated.

Each pipe length, fitting and special joint shall have plainly marked on the bell end of the pipe, the head condition for which it is designed. In addition, marking shall be required to indicate the location of each pipe length or special joint in the line and such markings will be referenced to the layout schedules and drawings and submitted for approval.

Concrete steel cylinder fittings shall be tested as required by the applicable AWWA Standards.

2. Design and Inspection

Where not otherwise indicated, concrete steel cylinder pipe shall be Class 150, designed to withstand a vacuum of not less than 28 feet of water. Valve reducers, tees and outlets from a pipe run shall be designed and fabricated so that all stresses are carried by the steel forming the fitting or outlet.

Concrete steel cylinder pipe shall meet one of the following specifications:

AWWA C-301 - Any Size

AWWA C-303 - 24-inch maximum size

All pipe flanges shall conform to AWWA C-207, requirements for standard steel flanges of pressure classes corresponding to the pipe class.

Pipe to be installed in a tunnel or encasement shall be manufactured with 1 inch thick by 24-inch wide skid bands of mechanically impacted mortar in addition to the normal coating.

All concrete steel cylinder fittings shall be constructed of steel plate of adequate strength to withstand both internal pressure and external loading. Rod reinforcing shall not be used to figure the required steel area. The fittings shall have a concrete lining and 1 inch minimum coating of cement mortar, except that centrifugally spun lining need not be reinforced.

Minimum lining thickness shall be ½ inch for 16-inch pipe and ¾ inch for sizes larger than 16-inch pipe. Where it is impractical to place such concrete protection on interior surfaces of small outlets, 2 coats of "Bitumastic Tank Solution" shall be applied.

No fitting shall be made by cutting of standard pipe, except that outlets of less than 75 percent of the pipe diameter may be placed in a standard pipe. Beveled spigots may be placed on standard pipe.

3. Joint Materials

Joints shall be of the rubber gasket type conforming to the applicable standards. The inside and outside recesses between the bell and spigot shall be completely filled with Cement Grout in accordance with the pipe manufacturer's recommendations. Grout materials for jointing such pipe, unless otherwise indicated, shall be as described herein.

(e) Reserved

(f) Polyethylene Tubing

1. General

All polyethylene (PE) tubing shall be high density, high molecular weight plastic tubing meeting ASTM D2737; it shall be pressure rated at 200 psi working pressure and must bear the National Sanitation Foundation seal of approval for potable water service. Pipe manufacturers shall be listed on SPL WW-65.

2. Materials

Polyethylene plastics shall be Designation PE3408 (Grade P34 with hydrostatic design stress of 800 psi).

3. Markings

Permanent marking on the tubing shall include the following at intervals of not more than 5 feet:

Nominal tubing size.

Type of plastic material, i.e., PE 3408.

Dimension Ratio (SDR) and pressure rating in psi for water at 73.4 F (e.g., SDR-9, 200 psi).

ASTM D 2737 designation.

Manufacturer's name or trademark, code and seal of approval (NSF mark) of the National Sanitation Foundation.

Polyethylene tubing for reclaimed service lines shall be purple.

4. Tube Size

PE tubing shall be standard copper tube size outside diameter, with Standard Dimension Ratio (SDR) of 9.

(g) Copper Tubing

All copper service tubing shall be annealed seamless Type K water tube meeting ASTM B88 and rated at 150 psi working pressure. The tubing shall be homogenous throughout and free from cracks, holes, crimping, foreign inclusions or other defects. It shall be uniform in density and other physical properties. Copper tubing for reclaimed water shall be wrapped in purple polyethylene film wrap. Pipe manufacturers shall be listed on SPL WW-613.

(h) Service Connection Fittings

All fittings used in customer service connection - tapping mains, connecting meters, etc. - must be currently listed on the applicable Water and Wastewater Standard Products List (SPL WW-68), or called for in the City of Austin Standard Details (520 - series).

(i) Brass Goods

All brass valves, couplings, bends, connections, nipples and miscellaneous brass pipe fittings and accessories used in meter connections, service lines, air release piping assemblies, and wherever needed in the water distribution system, shall conform to the City of Austin Standards, Austin Water Utility Standard Products Lists, and AWWA C-800, except as herein modified or supplemented.

Unless otherwise noted, the goods described herein shall be fabricated of standard Red Brass (Waterworks Brass) meeting ASTM B62 or B584, alloy 83600, consisting of 85 percent copper and 5 percent each of tin, lead and zinc.

Exposed threads shall be covered with plastic caps or sheeting to protect the threads.

Brass goods of each type and class shall be compatible with other fittings in common usage for similar purposes. Where not otherwise indicated, all such materials shall meet the following requirements:

Inlet threads of corporation valves shall be AWWA iron pipe (IP) thread (male); outlets of service saddles shall be tapped with AWWA IP thread (female). AWWA IP threads shall conform to ANSI/ASME B1.20.1 as required by AWWA C800 for "General Purpose (Inch) Pipe Threads". For ¾" and 1" sizes only, corporation valve inlet threads, and the internal threads of saddles may be the AWWA taper thread conforming to AWWA C800 Figure 1 and Table 6. External threads of corporation valve inlet must be compatible with internal threads of the service saddle.

Connections of all new tubing, and of tubing repairs wherever possible, shall be by compression fittings. Compression connections shall be designed to provide a seal and to retain the tubing, without slippage, at a working water pressure of 150 psig.

Flanges shall conform to ANSI B16.1, Class 125, as to dimensions, drillings, etc. Copper tubing, when used, shall be Type K tubing having dimensions and weights given in Table A.1 of AWWA C800.

Brass pipe shall conform to the weights and dimensions for Extra Strong pipe given in Table A.2 of AWWA C800.

All fittings shall be suitable for use at hydrostatic working pressures up to 150 psig (hydrostatic testing of installed systems is at 200 psig).

(j) Reserved

(k) Polyvinyl Chloride Potable/Reclaimed Water Pipe

1. General

All polyvinyl chloride (PVC) potable/reclaimed water pipe shall be of the rigid (UNPLASTICIZED) type and must bear the National Sanitation Foundation seal of approval for potable water pipe. Each joint of pipe shall consist of single continuous extrusion; bells or other components attached by solvent welding are not acceptable. Pipe shall be pressure rated at 200 psi (SDR-14).

Pipe shall have push-on, rubber gasket joints of the bell and spigot type with thickened integral bells with rubber gasket joints. The wall thickness of each pipe bell and joint coupling must be greater than the standard pipe barrel thickness. Clearance must be provided in every gasket joint for both lateral pipe deflection and for linear expansion and contraction. Concrete thrust blocking shall be placed behind bends and tees. Concrete support cradles or blocking shall be required for support of all fire hydrants, valves and AWWA C110 fittings; such support shall be provided for AWWA C153 fittings when required by the E/A.

2. Applicable Specifications

Except as modified or supplemented herein, PVC pipe shall meet the following standards: AWWA C-900, or SDR 14 for PVC Pressure Pipe, in 4, 6, 8 and 12 inch nominal sizes, having Cast Iron Pipe size outside diameters.

Fittings used with PVC Pressure pipe shall be AWWA C-110 or AWWA C-153 compact ductile iron fittings.

All pipe 4 inches and larger must be approved Underwriter's Laboratories for use in buried water supply and fire protection systems.

3. Material Requirements

All pipe and fittings shall be made from clean, virgin, NSF certified, Class 12454B PVC. Clean reworked materials generated from the manufacturers own production may be used within the current limits of the referenced AWWA C-900.

4. Marking

PVC for reclaimed piping shall be purple or wrapped in purple polyethylene film wrap.

Permanent marking on each joint of pipe shall include the following at intervals of not more than 5 feet:

Nominal pipe size and OD base (e.g., 4 CIPS).

Type of plastic material (e.g., PVC 12454B).

Standard Dimension Ratio and the pressure rating in psi for water at 73 F (e.g., SDR 18, 150 psi).

AWWA designation with which the pipe complies (e.g., AWWA C-900).

Manufacturer's name or code and the National Sanitation Foundation (NSF) mark.

5. Tracer Tape

Inductive Tracer Detection Tape shall be placed directly above the centerline of all non-metallic pipe a minimum of 12 inches below subgrade or, in areas outside the limits of pavement, a minimum of 18 inches below finished grade. The tracer tape shall be encased

in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape shall be placed according to manufacturer's recommendations. Manufacturers must be listed on SPL WW-597.

(I) Polyvinyl Chloride (PVC) Pipe (Nonpressure) and Fittings

1. General

PVC sewer and wastewater pipe and fittings 6 through 15 inch diameter shall conform to ASTM D 3034. Pipe shall have minimum cell classification of 12364 or 12454. Fittings shall have cell classification of 12454 or 13343. Pipe stiffness shall be at least 115 psi as determined by ASTM D 2412. Pipe manufacturers shall be on SPL WW-227, and fitting manufacturers shall be on SPL WW-227B.

PVC sewer and wastewater pipe and fittings 18 through 27 inch diameter shall conform to ASTM F 679. Pipe shall have minimum cell classification of 12364 or 12454. Pipe stiffness shall be at least 72 psi as determined by ASTM D 2412. Pipe manufacturers shall be on SPL WW-227A, and fitting manufacturers shall be on SPL WW-227B.

2. Joints

PVC pipe and fitting shall have elastomeric gasket joints conforming to ASTM D 3212. Gaskets shall conform to ASTM F 477.

3. Pipe Markings

Pipe meeting ASTM D 3034 shall have permanent marking on the pipe that includes the following at intervals of not more than 5 feet:

Manufacturer's name and/or trademark and code.

Nominal pipe size.

PVC cell classification per ASTM D 1784.

The legend "SDR-__ PVC Sewer Pipe" (SDR 26, 23.5. or less is required)

The designation "ASTM D 3034"

Pipe meeting ASTM F 679 shall have permanent marking that includes the following at intervals of not more than 5 feet:

Manufacturer's name or trademark and code

Nominal pipe size

PVC cell classification per ASTM D 1784

Pipe stiffness designation "PS __ PVC Sewer Pipe" (PS of at least 72 is required)

The designation "ASTM F 679"

4. Fitting Markings

Fittings meeting ASTM D 3034 shall have permanent marking that includes the following:

Manufacturer's name or trademark

Nominal size

The material designation "PVC"

The designation, "ASTM F 679"

Fittings meeting ASTM F 679 shall have permanent marking that includes the following:

Manufacturer's name or trademark and code

Nominal size

The material designation "PVC"

The designation "ASTM F 679"

5. Tracer Tape

Inductive Tracer Detection Tape shall be placed directly above the centerline of all non-metallic pipe a minimum of 12 inches below subgrade or, in areas outside the limits of pavement, a minimum of 18 inches below finished grade. The tracer tape shall be encased in a protective, inert, plastic jacket and color coded according to American Public Works Association Uniform Color Code. Except for minimum depth of cover, the tracer tape shall be placed according to manufacturer's recommendations. Manufacturers must be listed on SPL WW-597.

(m) Steel Pipe

1. Standard Weight

ASTM A 53, Schedule 40.

2. Extra Heavy Weight

Seamless ASTM A 53, Schedule 80.

3. Encasement Pipe

a. For direct-bury installations, pipe shall conform to ASTM A134 with minimum thickness of 3/8 inch (9.5 mm).

b. For jacked installations, pipe shall conform to requirements on drawings.

4. Fittings

Nipples and fittings extra strong Federal Specification WW-N 351 or WW-P 521.

5. Coatings

Black or galvanized as indicated.

(n) Welded Steel Pipe and Fittings for Water-Pipe

1. General Reference Standards Specification.

Specifications of the American Water Works Association (AWWA) listed below shall apply to this Section.

C-200 Steel Water Pipe 6 inches and larger.

C-205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 inches and larger, Shop Applied.

C-206 Field Welding of Steel Water Pipe.

C-207 Steel Pipe Flanges for Waterworks Services, Sizes 4 inches through 144 inches.

C-208 Dimensions for Steel Water Pipe Fittings.

C-602 Cement-Mortar Lining of Water Pipelines, 4 inches and larger in Place.

2. Submittals

Furnish Shop Drawings, product data, design calculations and test reports as described below:

- a. Certified copies of mill tests confirming the type of materials used in steel plates, mill pipe flanges and bolts and nuts to show compliance with the requirements of the applicable standards.
- b. Complete and dimensional working drawings of all pipe layouts. Shop Drawings shall include the grade of material, size, wall thickness of the pipe and fittings, type and location of fittings and the type and limits of the lining and coating systems of the pipe and fittings.
- c. Product data to show compliance of all couplings, supports, fittings, coatings and related items.

3. Job Conditions

- a. The internal design pressure of all steel pipe and fittings shall be as indicated.
- b. The interior of all steel pipe for potable water, 4 inches and larger, shall be cement-mortar lined.

4. Manufacturing

a. Description

Pipe shall comply with AWWA C-200.

- (1) Circumferential deflection of all pipe in-place shall not exceed 2.0 percent of pipe diameter.
- (2) Diameter

Nominal pipe diameter shall be the inside diameter of lining or pipe barrel, unless otherwise designated in Job Conditions.

b. Wall Thickness

- (1) Steel pipe wall thickness shall be designed for the internal and external loads specified in this section. The cylinder thickness needed to resist internal pressure shall be based on an allowable stress in the steel equal to $\frac{1}{2}$ the minimum yield stress of the material used.

5. Fittings

a. Welded

Fabricated steel fittings shall be of the same material as pipe and shall comply with AWWA C-208.

6. Flanges

- a. Flanges shall comply with the requirements of AWWA C-207, Class D or Class E. The class shall be based on operating conditions and mating flanges of valves and equipment.
- b. Gaskets shall be cloth-inserted rubber, $\frac{1}{8}$ inch thick.

-
- c. Flanges shall be flat faced with a serrated finish.

7. Pipe Joints

a. Lap Joints for Field Welding

- (1) Lap joints for field welding shall conform to AWWA C-206. This item applies only to pipes 72 inches in diameter and larger.
- (2) The bell ends shall be formed by pressing on a hydraulic expander or a plug die. After forming, the minimum radius of curvature of the bell end at any point shall not be less than 15 times the thickness of the steel shell. Bell ends shall be formed in a manner to avoid impairment of the physical properties of the steel shell. Joints shall permit a lap at least 1 ½ inches when assembled. The longitudinal or spiral weld on the inside of the bell end and the outside of the spigot end on each section of pipe shall be ground flush with the plate surface. The inside edge of the bell and the outside edge of the spigot shall be scarfed or lightly ground to remove the sharp edges or burrs.

b. Bell and Spigot Joints with O-Ring Gasket

- (1) Bell and spigot joints with rubber gasket shall conform to AWWA C-200.
- (2) The bell and spigot ends shall be so designed that when the joint is assembled, it will be self-centered and the gasket will be confined to an annular space in such manner that movement of the pipe or hydrostatic pressure cannot displace it. Compression of the gasket when the joint is completed shall not be dependent upon water pressure in the pipe and shall be adequate to ensure a watertight seal when subjected to the specified conditions of service. Bell and spigot ends shall be welded on preformed shapes. The bell and spigot ends shall conform to the reviewed Shop Drawings.

8. Interior and Exterior Protective Surface Coatings

- a. Exterior Surface to be mortar coated shall conform to AWWA C-205 for shop application and AWWA C-602 for field application. Pipe materials shall be the product of an organization, which has had not less than 5 years successful experience manufacturing pipe materials, and the design and manufacture of the pipe, including all materials, shall be the product of one company.
- b. All surfaces except as noted in c and d below shall receive shop application of mortar lining and coating.
- c. Field Welded Joints. After installation, clean, line and coat unlined or uncoated ends adjacent to welded field joints, including the weld proper, as specified for pipe adjacent to the weld. Potable water only shall be used in the preparation of any cement, mortar, or grout lining.
- d. Machined Surfaces. Shop coat machined surfaces with a rust preventative compound. After jointing surfaces, remaining exposed surfaces shall be coated per a) and b) above.

(o) Corrugated Metal Pipe

1. General

Pipe shall be corrugated continuous lock or welded seam helically corrugated pipe. Corrugated metal pipe may be galvanized steel, aluminized steel or aluminum conforming to the following:

Galvanized Steel AASHTO M 218

Aluminized Steel AASHTO M 274

Aluminum AASHTO M 197

Where reference is made herein to gage of metal, the reference is to U.S. Standard Gage for uncoated sheets. Tables in AASHTO M 218 and AASHTO M 274 list thickness for coated sheets in inches. The Tables in AASHTO M 197 list thickness in inches for clad aluminum sheets.

Sampling and testing of metal sheets and coils used for corrugated metal pipe shall be in accordance with TXDOT Test Method Tex-708-I.

Damaged spelter coating shall be repaired by thoroughly wire brushing the damaged area and removing all loose, cracked or weld-burned spelter coating. The cleaned area shall be painted with a zinc dust-zinc oxide paint conforming to Federal Specifications TT-P 641b. Damaged pipe shall be rejected and removed from the project.

Damaged aluminized coating shall be repaired in accordance with the manufacturer's recommendations.

The following information shall be clearly marked on each section of pipe:

Thickness and corrugations

Trade Mark of the manufacturer

Specification compliance

2. Fabrication

a. Steel Pipe

Galvanized or aluminized steel pipe shall be full circle or arch pipe conforming to AASHTO M 36, Type I or Type II as indicated.

It may be fabricated with circumferential corrugations; lap joint construction with riveted or spot welded seams or it may be fabricated with helical corrugations with continuous helical lock seam or ultra high frequency resistance butt-welded seams.

b. Aluminum Pipe

Pipe shall conform to AASHTO M 196, Type I, circular pipe or Type II, pipe arch as indicated. It may be fabricated with circumferential corrugations; lap joint construction with riveted or spot welded seams or it may be fabricated with helical corrugations with a continuous helical lock seam.

Portions of aluminum pipe that are to be in contact with high chloride concrete or metal other than aluminum, shall be insulated from these materials by a coating of bituminous material. The coating applied to the pipe or pipe arch to provide insulation between the aluminum and other material shall extend a minimum distance of 1 foot beyond the area of contact.

3. Selection of Gages

The pipe diameter, permissible corrugations and required gauges for circular pipe shall be as indicated on the drawings.

For pipe arch, the span, rise, gage, corrugation size and coating thickness shall be as shown on the drawings. A tolerance of plus or minus 1 inch or 2 percent of equivalent circular diameter, whichever is greater, will be permissible in span and rise, with all dimensions measured from the inside crests of the corrugations.

4. Joint Material

Except as otherwise indicated, coupling bands and other hardware for galvanized or aluminized steel pipe shall conform to AASHTO M 36 for steel pipe and AASHTO M 196 for aluminum pipe. Field joints for each type of corrugated metal pipe shall maintain pipe alignment during construction and prevent infiltration of soil material during the life of the installation.

Coupling bands shall be not more than 3 nominal sheet thickness lighter than the thickness of the pipe to be connected and in no case lighter than 0.052 inch for steel or 0.048 inch for aluminum.

Coupling bands shall be made of the same base metal and coating (metallic or otherwise) as the pipe.

Coupling bands shall lap equally on each of the pipes being connected to form a tightly closed joint after installation.

Pipes furnished with circumferential corrugations shall be field jointed with corrugated locking bands. This includes pipe with helical corrugations, which has reformed circumferential corrugations on the ends. The locking bands shall securely fit into at least one full circumferential corrugation on each of the pipe ends being coupled. The minimum width of the corrugated locking bands shall be as shown below for the corrugation which corresponds to the end circumferential corrugations on the pipes being joined:

10½ inches wide for 2 ⅔ inches × ½-inch corrugations.

12 inches wide for 3 inches × 1 inch or 5 inches × 1-inch corrugations.

Helical pipe without circumferential end corrugations will be permitted only when it is necessary to join a new pipe to an existing pipe, which was installed with no circumferential end corrugations. In this event pipe furnished with helical corrugations at the ends shall be field jointed with either helically corrugated bands or with bands with projections or dimples. The minimum width of helically corrugated bands shall conform to the following:

12 inches wide for pipe diameters up to and including 72 inches.

14 inches wide for 1 inch deep helical end corrugations.

Bands with projections shall have circumferential rows of projections with one projection for each corrugation. The width of bands with projections shall be not less than the following:

12 inches wide for pipe diameters up to and including 72 inches.

The bands shall have 2 circumferential rows of projections.

16¼ inches wide for pipe diameters of 78 inches and greater.

The bands shall have 4 circumferential rows of projections.

Unless otherwise indicated, all bolts for coupling bands shall be ½-inch diameter. Bands 12 inches wide or less shall have a minimum of 2 bolts and bands greater than 12 inches wide shall have a minimum of 3 bolts.

Galvanized bolts may be hot dip galvanized conforming to AASHTO M 232, mechanically galvanized to provide the same requirements as AASHTO M 232 or electro-galvanized per ASTM A 164 Type RS.

5. Additional Coatings or Linings

a. Bituminous Coated

Bituminous Coated pipe or pipe arch shall be as indicated both as to base metal and fabrication and in addition shall be coated inside and out with a bituminous coating which shall meet the performance requirements set forth herein. The bituminous coating shall be 99.5 percent soluble in carbon bisulphide. The pipe shall be uniformly coated inside and out to a minimum thickness of 0.05 inch, measured on the crests of the corrugations.

The bituminous coating shall adhere to the metal tenaciously, shall not chip off in handling and shall protect the pipe from deterioration as evidenced by samples prepared from the coating material successfully meeting the Shock Test and Flow Test in accordance with Test Method Tex-522-C.

b. Paved Invert

Where a Paved Invert is indicated, the pipe or pipe arch, in addition to the fully coated treatment described above, shall receive additional bituminous material of the same specification as above, applied to the bottom quarter of the circumference to form a smooth pavement with a minimum thickness of ½inch above the crests of the corrugations.

c. Cement Lined

(1) General

Except as modified herein, pipe shall conform to AASHTO M 36 for lock seam or welded helically corrugated steel pipe. Pipe shall be of full circle and shall be fabricated with two annular corrugations for purposes of joining pipes together with band couplers. Lock seams shall develop the seam strength as required in Table 3 of AASHTO M 36. Concrete lining shall conform to the following:

Composition

Concrete for the lining shall be composed of cement, fine aggregate and water that are well mixed and of such consistency as to produce a dense, homogeneous, non-segregated lining.

Cement

Portland Cement shall conform to AASHTO M 85.

Aggregate

Aggregates shall conform to AASHTO M 6 except that the requirements for gradation and uniformity of gradation shall not apply.

Mixture

The aggregates shall be sized, graded, proportioned and thoroughly mixed with such proportions of cement and water as will produce a homogenous concrete mixture of such quality that the pipe will conform to the design requirements indicated. In no case, however, shall the proportions of Portland Cement, blended cement or Portland Cement plus pozzolanic admixture be less than 470 lb/cu. yd of concrete.

Thickness

The lining shall have a minimum thickness of $\frac{1}{8}$ inch above the crest of the corrugations.

Lining Procedures

The lining shall be plant applied by a machine traveling through a stationary pipe. The rate of travel of the machine and the rate of concrete placement shall be mechanically regulated so as to produce a homogenous nonsegregated lining throughout.

Surface Finish

The lining machine shall also mechanically trowel the concrete lining as the unit moves through the pipe.

Certification

Furnish manufacturer's standard certification of compliance upon request of the purchaser.

Joints

Pipe shall be joined together with coupling bands made from steel sheets to an indicated thickness of 0.064 inch (12 ga.). Coupling bands shall be formed with two corrugations that are spaced to provide seating in the third corrugation of each pipe end without creating more than $\frac{1}{2}$ inch \pm annular space between pipe ends when joined together.

Bands shall be drawn together by two $\frac{1}{2}$ inch galvanized bolts through the use of a bar and strap suitably welded to the band.

When O-ring gaskets are indicated they shall be placed in the first corrugation of each pipe and shall be compressed by tightening the coupling band. Rubber O-ring gaskets shall conform to Section 5.9, ASTM C 361.

(2) Causes for Rejection

Pipe shall be subject to rejection on account of failure to conform to any of the indications. Individual sections of pipe may be rejected because of any of the following:

Damaged ends, where such damage would prevent making satisfactory joint.

Defects that indicate poor quality of work and could not be easily repaired in the field.

Severe dents or bends in the metal itself.

If concrete lining is broken out, pipe may be rejected or at the discretion of the E/A, repaired in the field in accordance with the manufacturer's recommendation.

Hairline cracks or contraction cracks in the concrete lining are to be expected and does not constitute cause for rejection.

d. Fiber Bonded

Where fiber bonded pipe is indicated, the pipe or pipe arch shall be formed from sheets whose base metal shall be as indicated. In addition, the sheets shall have been coated with a layer of fibers, applied in sheet form by pressing them into a molten metallic bonding. If a paved invert is indicated it shall be in accordance with the procedure outlined above. The test for spelter coating above is waived for fiber bonded pipe.

6. Slotted Drain Storm Sewers

The pipes for the slotted drain and slotted drain outfall shall be helically corrugated, lock seam or welded seam pipe. Materials and fabrication shall be in accordance with the above. The metal thickness shall be a minimum 16 gage.

The chimney assemblies shall be constructed of 3/16 inch welded plate or machine formed 14 gage galvanized steel sheets. The height of the chimney required shall be as indicated. Metal for the welded plate slot shall meet the requirements of ASTM A 36 and the completed plate slot shall be galvanized after fabrication in accordance with ASTM A 123.

Weld areas and the heat affected zones where the slot is welded to the corrugated pipe shall be thoroughly cleaned and painted with a good quality asphalt base aluminum paint.

7. Mortar

Mortar shall be composed of 1 part Type I Portland Cement and 2 parts clean, sharp mortar sand suitably graded for the purpose and conforming in other respects to the provisions for fine aggregate of Item No. 403, "Concrete for Structures". Hydrated lime or lime putty may be added to the mix, but in no case shall it exceed 10 percent by weight of the total dry mix.

(9) Geotextile Filter Fabric for Pipe Bedding Material

Geotextile filter fabric for pipe bedding material shall be Hanes Geo Components - TerraTex NO4.5 (AOS US Standard Sieve 70) geotextile fabric or approved equal.

510.3 Construction Methods

(1) General

Prior to commencing this Work, all erosion control and tree protection measures required shall be in place and all utilities located and protected as set forth in "General Conditions". Clearing the site shall conform to Item No. 102S, "Clearing and Grubbing". Maintenance of environmental quality protection shall comply with all requirements of "General Conditions" and Item No. 601S, "Salvaging and Placing Topsoil".

The Contractor shall Work such that a reasonable minimum of disturbance to existing utilities will result. Particular care shall be exercised to avoid the cutting or breakage of all existing utilities. If at any time the Contractor's operations damage the utilities in place, the Contractor shall immediately notify the owner of the utility to make the necessary repairs. When active wastewater sewer lines are cut in

the trenching operations, temporary flumes shall be provided across the trench while open and the lines shall be restored when the backfilling has progressed to the original bedding lines of the sewer so cut.

The Contractor shall inform utility owners sufficiently in advance of the Contractor's operations to enable such utility owners to reroute, provide temporary detours or to make other adjustments to utility lines in order that the Contractor may Work with a minimum of delay and expense. The Contractor shall cooperate with all utility owners concerned in effecting any utility adjustments necessary and shall not hold the City liable for any expense due to delay or additional Work because of conflicts arising from existing utilities.

The Contractor shall do all trenching in accordance with the provisions and the directions of the E/A as to the amount of trench left unfilled at any time. All excavation and backfilling shall be accomplished as indicated and in compliance with State Statutes.

Where excavation for a pipe line is required in an existing City street, a street cut permit is required and control of traffic shall be as indicated in accordance with the Texas Manual on Uniform Traffic Control Devices.

Wherever existing utility branch connections, sewers, drains, conduits, ducts, pipes or structures present obstructions to the grade and alignment of the pipe, they shall be permanently supported, removed, relocated or reconstructed by the Contractor through cooperation with the owner of the utility, structure or obstruction involved. In those instances where their relocation or reconstruction is impractical, a deviation from line and grade will be ordered by the E/A and the change shall be made in the manner directed.

Adequate temporary support, protection and maintenance of all underground and surface utility structures, drains, sewers and other obstructions encountered in the progress of the Work shall be furnished by, and at the expense of, the Contractor and as approved by the E/A.

Where traffic must cross open trenches, the Contractor shall provide suitable bridges in conformance with Standard 804S-4. Adequate provisions shall be made for the flow of sewers; drains and watercourses encountered during construction and any structures, which may have been disturbed, shall be satisfactorily restored upon completion of Work.

When rainfall or runoff is occurring or is forecast by the U.S. Weather Service, the Contractor shall not perform or attempt any excavation or other earth moving Work in or near the flood plain of any stream or watercourse or on slopes subject to erosion or runoff, unless given specific approval by the E/A. When such conditions delay the Work, an extension of time for working day contracts will be allowed in accordance with "General Conditions".

(2) Water Line/New Wastewater Line Separation

Separation between water, reclaimed water, and wastewater lines shall be provided as shown in the Drawings.

Crossings of water, reclaimed water, and wastewater lines shall conform to details in the Drawings.

Wastewater manholes within 9 feet of water and reclaimed water lines shall be made watertight according to details in the Drawings.

(3) Utility and Storm Sewer Crossings

When the Contractor installs a pipe that crosses under a utility or storm sewer structure and the top of the pipe is within 18 inches of the bottom of the structure, the pipe shall be backfilled as shown in the Drawings. When the Contractor installs a pipe that crosses under a utility or storm sewer structure that is not shown in the Drawings, the pipe shall be backfilled as directed by the Engineer. Payment for

backfilling pipe at utility or storm sewer structures not shown in the Drawings shall be by Change Order.

(4) Trench Excavation

Excavation in a paved street shall be preceded by saw cutting completely through any asphaltic cement concrete or Portland cement concrete surface, base, or subbase to the underlying subgrade. This requirement shall not apply to excavations made with trenching machines that use a rotating continuous belt or chain for cutting and removing of material.

Underground piped utilities shall be constructed in an open cut in accordance with Federal regulations, applicable State Statutes conforming to Item No. 509S, "Excavation Safety Systems" and with a trench width and depth described below. When pipe is to be constructed in fill above the natural ground, Contractor shall construct embankment to an elevation not less than one foot above the top of the pipe, after which trench is excavated. Required vertical sides shall be sheeted and braced as indicated to maintain the sides of the required vertical excavation throughout the construction period. Adequacy of the design of sheeting and bracing shall be the responsibility of the Contractor's design professional. The Contractor shall be responsible for installation as indicated. After the pipe has been laid and the backfill placed and compacted to 12 inches above the top of the pipe, any sheeting, shoring and bracing required may be removed with special care to insure that the pipe is not disturbed. As each piece of sheeting is removed, the space left by its removal must be thoroughly filled and compacted with suitable material and provisions made to prevent the sides of the trench from caving until the backfill has been completed. Any sheeting left in place will not be paid for and shall be included in the unit price bid for pipe.

(5) Trench Width

Trenches for water, reclaimed, and wastewater lines shall have a clear width on each side beyond the outside surfaces of the pipe bell or coupling of not less than 6 inches nor more than 12 inches.

Trenches for Storm Sewers up to 42 inches shall have a width of 1 foot on each side beyond the outside surfaces of the pipe. Pipes more than 42 inches shall have a trench width not to exceed 18 inches on each side beyond the outside surfaces of the pipe.

If the trench width within the pipe zone exceeds this maximum, the entire pipe zone shall be refilled with approved backfill material, thoroughly compacted to a minimum of 95 percent of maximum density as determined by TxDOT Test Method Tex-114-E and then re-excavated to the proper grade and dimensions. Excavation along curves and bends shall be so oriented that the trench and pipe are approximately centered on the centerline of the curve, using short lengths of pipe and/or bend fittings if necessary.

For all utilities to be constructed in fill above natural ground, the embankment shall first be constructed to an elevation not less than 1 foot above the top of the utility after which excavation for the utility shall be made.

(6) Trench Depth and Depth of Cover

All pipe and in-line appurtenances shall be laid to the grades indicated. The depth of cover shall be measured from the established finish grade, natural ground surface, subgrade for staged construction, street or other permanent surface to the top or uppermost projection of the pipe.

(a) Where not otherwise indicated, all potable/reclaimed water piping shall be laid to the following minimum depths:

1. Potable/reclaimed water piping installed in undisturbed ground in easements of undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 36 inches of cover.

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2. Potable/reclaimed water piping installed in existing streets, roads or other traffic areas shall be laid with at least 48 inches of cover below finish grade.
 3. Unless approved by the E/A, installation of potable/reclaimed water piping in proposed new streets will not be permitted until paving and drainage plans have been approved and the roadway traffic areas excavated to the specified or standard paving subgrade, with all parkways and sidewalk areas graded according to any applicable provisions of the drainage plans or sloped upward from the curb line to the right-of-way line at a minimum slope of ¼ inch per foot. Piping and appurtenances installed in such proposed streets shall be laid with at least 36 inches of cover below the actual subgrade.
- (b) Where not otherwise indicated, all wastewater piping shall be laid to the following minimum depths:
1. Wastewater piping installed in natural ground in easements or other undeveloped areas, which are not within existing or planned streets, roads or other traffic areas shall be laid with at least 42 inches of cover.
 2. Wastewater piping installed in existing streets, roads or other traffic areas shall be laid with at least 66 inches of cover.
 3. Wastewater piping installed in such proposed streets shall be laid with at least 48 inches of cover below the actual subgrade.

(7) Classification of Excavation

Excavation will not be considered or paid for as a separate item of Work, so excavated material will not be classified as to type or measured as to quantity. Full payment for all excavation required for the construction shall be included in the various unit or lump sum Contract prices for the various items of Work installed, complete in place. No extra compensation, special treatment or other consideration will be allowed due to rock, pavement, caving, sheeting and bracing, falling or rising water, working under and in the proximity of trees or any other handicaps to excavation.

(8) Dewatering Excavation

Underground piped utilities shall not be constructed or the pipe laid in the presence of water. All water shall be removed from the excavation prior to the pipe placing operation to insure a dry firm granular bed on which to place the underground piped utilities and shall be maintained in such unwatered condition until all concrete and mortar is set. Removal of water may be accomplished by bailing, pumping or by a well-point installation as conditions warrant.

In the event that the excavation cannot be dewatered to the point where the pipe bedding is free of mud, a seal shall be used in the bottom of the excavation. Such seal shall consist of Class B concrete, conforming to Item No. 403, "Concrete for Structures", with a minimum depth of 3 inches.

(9) Trench Conditions

Before attempting to lay pipe, all water, slush, debris, loose material, etc., encountered in the trench must be pumped or bailed out and the trench must be kept clean and dry while the pipe is laid and backfilled. Where needed, sump pits shall be dug adjoining the trench and pumped as necessary to keep the excavation dewatered.

Backfilling shall closely follow pipe laying so that no pipe is left exposed and unattended after initial assembly. All open ends, outlets or other openings in the pipe shall be protected from damage and shall be properly plugged and blocked watertight to prevent the entrance of trench water, dirt, etc. The interior of the pipeline shall at all times be kept clean, dry and unobstructed.

Where the soil encountered at established footing grade is a quicksand, saturated or unstable material, the following procedure shall be used unless other methods are indicated:

All unstable soils shall be removed to a depth of a minimum 2 feet below bottom of piped utility or as required to stabilize the trench foundation. Such excavation shall be carried out for the entire trench width.

All unstable soil so removed shall be replaced with a concrete seal, foundation rock or coarse aggregate materials placed across the entire trench width in uniform layers not to exceed 6 inches, loose measure and compacted by mechanical tamping or other means which shall provide a stable foundation for the utility.

Forms, sheathing and bracing, pumping, additional excavation and backfill required in unstable trench conditions shall be included in the unit price bid for pipe.

(10) Blasting

All blasting shall conform to the provisions of the "General Conditions" and/or "Public Safety and Convenience".

(11) Removing Old Structures

When out of service masonry structures or foundations are encountered in the excavation, such obstructions shall be removed for the full width of the trench and to a depth of 1 foot below the bottom of the trench. When abandoned inlets or manholes are encountered and no plan provision is made for adjustment or connection to the new sewers, such manholes and inlets within the construction limits shall be removed completely to a depth 1 foot below the bottom of the trench. In each instance, the bottom of the trench shall be restored to grade by backfilling and compacting by the methods provided above. Where the trench cuts through storm or wastewater sewers which are known to be abandoned, these sewers shall be cut flush with the sides of the trench and blocked with a concrete plug in a manner satisfactory to the E/A. When old structures are encountered, which are not visible from the existing surface and are still in service, they shall be protected and adjusted as required to the finished grade.

(12) Lines and Grades

Grades, lines and levels shall conform to the General Conditions and/or "Grades, Lines and Levels". Any damage to the above by the Contractor shall be re-established at the Contractor's expense. The Contractor shall furnish copies of all field notes and "cut sheets" to the City.

The location of the lines and grades indicated may be changed only by direction of the E/A. It is understood that the Contractor will be paid for Work actually performed on the basis of the unit Contract prices and that the Contractor shall make no claim for damages or loss of anticipated profits due to the change of location or grade.

All necessary batter boards or electronic devices for controlling the Work shall be furnished by, and at the expense of, the Contractor. Batter boards shall be of adequate size material and shall be supported substantially. The boards and all location stakes must be protected from possible damage or change of location. The Contractor shall furnish good, sound twilled lines for use in achieving lines and grades and the necessary plummets and graduated poles.

The Contractor shall submit to the E/A at least 6 copies of any layout Drawings from the pipe manufacturer for review and approval. The Contractor shall submit the layout Drawings at least 30 days in advance of any actual construction of the project. The E/A will forward all comments of the review to the Contractor for revision. Revisions shall be made and forwarded to the E/A for his acceptance. Prior to commencement of the Project, reviewed layout Drawings will be sent to the Contractor marked for construction.

Should the Contractor's procedures not produce a finished pipe placed to grade and alignment, the pipe shall be removed and relayed and the Contractors procedures modified to the satisfaction of the E/A. No additional compensation shall be paid for the removal and relaying of pipe required above.

(13) Surplus Excavated Materials

Excess material or material which cannot be made suitable for use in embankments will be declared surplus by the E/A and shall become the property of the Contractor to dispose of off site at a permitted fill site, without liability to the City or any individual. Such surplus material shall be removed from the Work site promptly following the completion of the portion of the utility involved.

(14) Pipe Bedding Envelope

Pipe shall be installed in a continuous bedding envelope of the type shown on the drawings or as described herein. The envelope shall extend the full trench width, to a depth of at least 6 inches (150 mm) below the pipe and to a depth of the springline of storm water pipe and at least 12 inches (300 mm) above water, reclaimed, and wastewater pipe.

(a) Standard Bedding Materials

USE/PIPE MATERIAL	Cement Stabilized Backfill	Natural or Mf'd Sand	Pea Gravel	PIPE BEDDING STONE			
				Uncrushed Gravel	Crushed Gravel	Crushed Stone	Stone Screenings
WATER and RECLAIMED WATER							
Welded Steel	X					X	
Service Tubing ¾" to 2½"		X	X				X
WATER and RECLAIMED WATER (Ductile Iron)							
Up to 15 Inch ID		X	X	X			X
Larger Than 15 Inch ID			X	X			
WATER and RECLAIMED WATER (PVC only) and WASTEWATER							
Up to 15 Inch ID		X	X	X	X	X	X
Larger Than 15 Inch ID			X	X	X	X	
STORMWATER							
Concrete		X	X	X	X	X	X
Metal		X	X	X			X

(b) General requirements and limitations governing bedding selection.

- (1) Crushed gravel or crushed stone shall not be used with polyethylene tubing or polyethylene film wrap.
- (2) Uncrushed gravel may be used with polyethylene film wrap in trenches up to 6 feet deep and in deeper trenches where ample trench width, a tremmie, or conditions will allow controlled placement of the gravel without damaging the polyethylene wrap.
- (3) Bedding shall be placed in lifts not exceeding 8 inches loose thickness and compacted thoroughly to provide uniform support for the pipe barrel and to fill all voids around the pipe.
- (4) Pea Gravel or bedding stone shall be used in blasted trenches.

(c) Requirements to prevent particle migration.

Bedding material shall be compatible with the materials in the trench bottom, walls and backfill so that particle migration from, into or through the bedding is minimized. The E/A may require one or more of the following measures to minimize particle migration: use of impervious cut-off collars; selected bedding materials, such as pea gravel or bedding stone mixed with sand; filter fabric envelopment of the bedding; cement stabilized backfill; or other approved materials or methods. Measures to minimize particle migration will be shown on the Drawings or designated by the E/A, and, unless provisions for payment are provided in the contract documents, the cost of these measures shall be agreed by change order. The following limitations shall apply.

- (1) Sand, alone, shall not be used in watercourses, in trenches where groundwater is present, or in trenches with grades greater than 5 percent.
- (2) Pea gravel or bedding stone, alone, shall not be used in the street right-of-way within 5 feet of subgrade elevation in trenches that are 3 feet or wider.
- (3) Each gravel or bedding stone, alone, shall not be used where the trench bottom, sides, or backfill is composed of non-cementitious, silty or sandy soils having plasticity indices less than 20, as determined by the E/A.
- (4) Sand, alone, shall not be used for installation of concrete storm water pipe unless the bedding envelope is wrapped with a geotextile membrane and the joints of the stormdrain conduit are wrapped to prevent the migration of fines into the bedding envelope and into the stormdrain conduit.
- (5) For concrete storm water pipe, if pea gravel, uncrushed gravel, crushed gravel, crushed stone, or combination thereof is used for pipe bedding material, a geotextile filter fabric shall be placed around the perimeter of the joint.

(15) Laying Pipe

No pipe shall be installed in the trench until excavation has been completed, the bottom of the trench graded and the trench completed as indicated.

Laying of corrugated metal pipes on the prepared foundation shall be started at the outlet end with the separate sections firmly joined together, with outside laps of circumferential joints pointing upstream and with longitudinal laps on the sides. Any metal in joints, which is not protected by galvanizing, shall be coated with suitable asphaltum paint. Proper facilities shall be provided for hoisting and lowering the sections of pipe into the trench without damaging the pipe or disturbing the prepared foundation and the sides of the trench. Any pipe which is not in alignment or which shows any undue settlement after laying or damage, shall be taken up and re-laid without extra compensation.

Multiple installations of corrugated pipe or arches shall be laid with the centerlines of individual barrels parallel. When not otherwise indicated, clear distances of 2 feet between outer surfaces of adjacent pipes shall be maintained.

No debris shall remain in the drainways or drainage structures.

All recommendations of the manufacturer shall be carefully observed during handling and installation of each material. Unless otherwise indicated, all materials shall be delivered to the project by the manufacturer or agent and unloaded as directed by the Contractor. Each piece shall be placed facing the proper direction near to where it will be installed.

The interior of all pipe, fittings and other accessories shall be kept free from dirt and foreign matter at all times and stored in a manner that will protect them from damage. Stockpiled materials shall be stacked so as to minimize entrance of foreign matter.

The interior of all pipeline components shall be clean, dry and unobstructed when installed.

Piping materials shall not be skidded or rolled against other pipe, etc. and under no circumstances shall pipe, fittings or other accessories be dropped or jolted.

During handling and placement, materials shall be carefully observed and inspected and any damaged, defective or unsound materials shall be marked, rejected and removed from the job site. Minor damage shall be marked and repaired in a manner satisfactory to the E/A. Joints, which have been placed, but not joined, backfilled, etc., shall be protected in a manner satisfactory to the E/A.

(16) Assembling of Pipe

Angular spacing of all joints shall meet the manufacturer's recommendations for the pipe and accessories being used. Side outlets shall be rotated so that the operating stems of valves shall be vertical when the valves are installed. Pressure pipe shall be laid with bell ends facing the direction of pipe installation. Pipe end bells shall be placed upgrade for all wastewater lines.

Orientation marks, when applicable, shall be in their proper position before pipe is seated.

Before joining any pipe, all foreign matter, lumps, blisters, excess coal tar coating, oil or grease shall be removed from the ends of each pipe and the pipe ends shall then be wire brushed and wiped clean and dry. Pipe ends shall be kept clean until joints are made.

Every precaution shall be taken to prevent foreign material from entering the pipe during installation. No debris, tools, clothing or other materials shall be placed in the pipe.

(17) Joints

(a) Mortar (Storm Drain joints only)

Pipe ends shall be clean, free of asphalt or other contaminants, which will inhibit the bond of the mortar to the pipe. The pipe ends shall be moistened immediately prior to placing the mortar in the joint.

(b) Cold Applied Preformed Plastic Gaskets (Storm Drain joints only)

The pipe ends shall be clean and the joint material applied to the dry pipe. In cold weather, the joint material shall be heated to facilitate the seal of the joint.

(c) O-Ring and Push-on Joints

Just before making a joint the ends of the pipe shall be clean, dry, free of any foreign matter, lump blisters, excessive coal tar coating and grease or oil and shall be wire brushed. The gasket and the inside surface of the bell shall be lubricated with a light film of soft vegetable soap compound (Flax Soap) to facilitate telescoping the joints. The rubber gasket if not factory installed shall be stretched uniformly as it is placed in the spigot groove to insure a uniform volume of rubber around the circumference of the groove. The spigot shall be centered in the bell, the pipe pushed home uniformly and brought into true alignment. Bedding material shall be placed and tamped against pipe to secure the joint. Care should be taken to prevent dirt or foreign matter from entering the joint space.

(d) Bolted Joints

All flanged, mechanical or other bolted joints shall be joined with nuts and bolts and be coated as indicated above in Iron Pipe.

(e) Storm Drain Joints

Storm drain joints sealed with preformed flexible joint sealants shall be provided and installed in compliance with ASTM C990. Storm drain joints sealed with rubber gaskets shall comply with ASTM C443 Install joint sealants in accordance with the pipe and joint sealant manufacturers'

recommendations. Place the joint sealer so that no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the pipe with enough force to properly seal the joint with the final joint opening (gap) on the inside of the installed pipe being less than or equal to the pipe manufacturer's recommended dimensions. Protrusion of joint material greater than $\frac{1}{8}$ " into the interior of the pipe will not be accepted. Excess joint material will be removed to within $\frac{1}{8}$ " of pipe surface. Observe joint sealant manufacturer's recommendations for installation temperature of the joint sealant. Apply joint sealant to pipe joint immediately before placing pipe in trench, and then connect pipe to previously laid pipe.

If inspection (video or other means) reveal C-990 joints that show signs of backfill infiltration, or where joints or conduits exhibit excessive joint gap or are otherwise defective, then the contractor has the following options:

1. Conduits less than 36-inches in any dimension: pour a concrete collar around the joint or wrap joint with a wrap meeting requirements of ASTM C-877 or approved equal.
2. Conduits greater than or equal to 36-inches in all dimensions: repair joints using joint repair techniques recommended by the manufacturer to achieve a completed system that meets all Contract requirements.

(18) Pressure Pipe Laying

(a) Grout for Concrete Steel Cylinder Pipe (CSC) and Welded Steel Pipe

Aggregate, cement, etc., shall be as indicated in "Mortar" herein. Potable water shall be used in the preparation of any cement, mortar, or grout lining.

Grout shall be poured into the recess between the bell and spigot on the outside of the pipe and contained by a joint wrapper ("diaper") recommended by the pipe manufacturer. The wrapper shall have a minimum width of 7 inches for 30 inch and smaller and 9 inches for larger pipe, secured to the pipe by "Band Iron" steel straps. The grout shall be poured in one continuous operation in such manner that after shrinkage and curing the joint recess shall be completely filled.

Mortar for the inside recess shall be of the consistency of plaster. The inside recess between the bell and spigot shall be filled with mortar after the pipe joint on either side of the recess has been backfilled and well tamped with no less than one pipe joint installed ahead of the pipe forming the recess. The mortar shall completely fill the recess and shall be trowelled and packed into place and finished off smooth with the inside of the pipe.

The Contractor shall inspect the joint after the mortar has set and make repairs of any pockets, cracks or other defects caused by shrinkage to the satisfaction of the E/A. The inside surface shall be cleared of any mortar droppings, cement, water, slurry, etc., before they have become set and shall be cleared of any other foreign matter. The inside surface of the pipe shall be left clean and smooth.

Pipe shall be handled at all times with wide non abrasive slings, belts or other equipment designed to prevent damage to the coating and all such equipment shall be kept in such repair that its continued use is not injurious to the coating. The use of tongs, bare pinch-bars, chain slings, rope slings without canvas covers, canvas or composition belt slings with protruding rivets, pipe hooks without proper padding or any other handling equipment, which the E/A deems to be injurious to the coating, shall not be permitted. The spacing of pipe supports required to handle the pipe shall be adequate to prevent cracking or damage to the cement mortar lining.

(19) Placing Pipe in Tunnels

Piping installed as a carrier pipe in a tunnel, encasement pipe, etc., shall have uniform alignment, grade, bearing and conform to the reviewed Shop Drawings. All necessary casing spacers, bedding material, grout cradle or paving, bracing, blocking, etc., as stipulated by the Contract or as may be required to provide and maintain the required pipe alignment and grade, shall be provided by the Contractor at no cost except as provided by the Bid Items. This shall include casing spacers acceptable to the Owner attached to the carrier pipe in accordance with the manufacturer's recommendations. The insertion pushing forces shall not exceed the pipe manufacturer's recommendation. Such carrier piping shall have flexible bolted or gasketed push-on joints or Concrete Steel Cylinder pipe installed as follows:

(a) 21 Inch Pipe and Smaller

Prior to placing the pipe in the tunnel, the inside joint recess at the bell shall be buttered with cement mortar.

After the joint is engaged, the excess mortar shall be smoothed by pulling a tight fitting swab through the joint. Cement mortar protection shall then be placed in the normal manner to the exterior of the joint and allowed to harden sufficiently to avoid dislodgment during installation. If time is of the essence, a quick setting compound may be used.

(b) 24 Inch Pipe and Larger

Each length of pipe shall be pushed into the tunnel as single units. A flexible mastic sealer shall be applied to the exterior of the joint prior to joint engagement. The surfaces receiving the mastic sealer shall be cleaned and primed in accordance with the manufacturer's recommendation. Sufficient quantities of the mastic sealer shall be applied to assure complete protection of all steel in the joint area. The interior of the joint shall be filled with cement mortar in the normal manner after the pipe is in its final position within the tunnel.

(20) Temporary Pipe Plugs, Caps, Bulkheads and Trench Caps

Temporary plugs, caps or plywood bulkheads shall be installed to close all openings of the pipe and fittings when pipeline construction is not in progress.

All temporary end plugs or caps shall be secured to the pipe as provided under Item No. 507, "Bulkheads".

Trench caps shall be reinforced Class D concrete as indicated.

(21) Corrosion Control

(a) Protective Covering

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other iron or steel components buried and in contact with earth or backfill shall be wrapped with 8-mil (minimum) polyethylene film meeting ANSI/AWWA C-105 to provide a continuous wrap.

(22) Pipe Anchorage, Support and Protection

Pressure pipeline tees, plugs, caps and bends exceeding 22½ degrees; other bends as directed shall be securely anchored by suitable concrete thrust blocking or by approved metal harness. Unless otherwise indicated, on 24 inch or larger piping, all bends greater than 11 ¼ degrees shall be anchored as described herein.

Storm sewers on steep grades shall be lugged as indicated.

(a) Concrete Thrust Blocking

Concrete for use as reaction or thrust blocking shall be Class B conforming to Item No. 403, "Concrete for Structures".

Concrete blocking shall be placed between solid ground and the fitting to be anchored. The area of bearing on the pipe and on the ground shall be as indicated or directed by the E/A. The blocking shall, unless otherwise indicated, be so placed that the pipe, fittings and joints will be accessible for repair.

The trench shall be excavated at least 6 inches outside the outermost projections of the pipe or appurtenance and the trench walls shaped or undercut according to the detail Drawings or as required to provide adequate space and bearing area for the concrete.

The pipe and fittings shall be adequately weighted and laterally braced to prevent floating, shifting or straining of the pipeline while the concrete is being placed and taking initial set. The Contractor shall be solely responsible for the sufficiency of such restraints.

(b) Metal Thrust Restraint

Fabricated thrust restraint systems such as those described below may be approved for use instead of concrete blocking. To obtain approval, the project Drawings must include sufficient drawings, notes, schedules, etc., to assure that the proposed restraints as installed will be adequate to prevent undesirable movement of the piping components. Such restraint systems may only be used where and as specifically detailed and scheduled on approved Project Drawings.

1. Thrust Harness

A metal thrust harness of tie rods, pipe clamps or lugs, turnbuckles, etc., may be approved. All carbon steel components of such systems, including nuts and washers, shall be hot-dip galvanized; all other members shall be cast ductile iron. After installation, the entire assembly shall be wrapped with 8-mil polyethylene film, overlapped and taped in place with duct tape to form a continuous protective wrap.

2. Restrained Joints

Piping or fitting systems utilizing integral mechanically restrained joints may be approved. All components of such systems shall be standard manufactured products fabricated from cast ductile iron, hot-dip galvanized steel, brass or other corrosion resistant materials and the entire assembly shall be protected with a continuous film wrap as described for 1. above. Manufacturers of pipe with restrained joints integral to the pipe shall be listed on SPL WW-27F. All pipe and fitting systems with restrained joints shall be identified by applying an adhesive-backed warning tape to the top of the pipe and for the full length of the pipe, regardless of the type of pipe. For plastic pipes the warning tape shall be applied directly to the top of the pipe. For metal pipes and fittings the warning tape shall be applied to the top of the polyethylene film wrap. The warning tape shall conform to 510.2(8)(b)5.

Location, configuration and description of such products shall be specifically detailed on the Drawings. (Add-on attachments such as retainer glands, all-thread rods, etc., are not acceptable.)

(c) Concrete Encasement, Cradles, Caps and Seals

When trench foundation is excessively wet or unstable or installation of water or wastewater pipe will result in less than 30 inches of cover, Contractor shall notify E/A. E/A may require Contractor to install a concrete seal, cradle, cap, encasement or other appropriate action.

All concrete cap, etc., shall be continuous and begin and end within 6 inches of pipe joints. Concrete cap, cradle and encasement shall conform to City of Austin Standard No. 510S-1, "Concrete Trench Cap". The pipe shall be well secured to prevent shifting or flotation while the concrete is being placed.

(d) Anchorage Bulkheads

Concrete bulkheads keyed into the undisturbed earth shall be placed as indicated to support and anchor the pipe and/or backfill against end thrust, slippage on slopes, etc. Concrete material and placement shall be Class A, Item No. 403, "Concrete for Structures".

(e) Trench Caps, Concrete Rip-Rap and Shaped Retards

Where called for by the Contract or as directed by the E/A, concrete trench caps, concrete rip-rap and/or shaped retards shall be placed as detailed by the Drawings as protection against erosion. Concrete material and placement shall be Class B, Item No. 403, "Concrete for Structures".

(23) Wastewater Connections

(a) Connections to Mains 12 Inches and Smaller

All branch connections of new main lines shall be made by use of manholes.

Service stubs shall be installed as indicated. Minimum grade shall be 1 percent downward to main and minimum cover shall be 4½ feet at the curb. Standard plugs shall be installed in the dead end before backfilling.

Where a service connection to a main 12 inches or smaller is indicated, a wye, tee or double wye shall be installed.

Where a service connection to a main 15 inches or larger is indicated, a field tap may be made with the pipes installed crown to crown. The tap should be made conforming to the pipe manufacturer's recommendations with the E/A's approval.

Where not otherwise indicated, (wastewater) service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

(b) Connections to the Existing System

Unless otherwise specified by the E/A, all connections made to existing mains shall be made at manholes with the crown of the inlet pipe installed at the same elevation as the crown of the existing pipe. Service stubs installed on the existing system shall be installed by use of tapping saddles unless otherwise approved by the E/A. Extreme care shall be exercised to prevent material from depositing in the existing pipe as the taps are being made.

When connections to existing mains are made, a temporary plug approved by the E/A must be installed downstream in the manhole to prevent water and debris from entering the existing system before Final Completion. These plugs shall be removed after the castings are adjusted to finish grade or prior to Final Completion.

(c) Connecting Existing Services to New Mains

Where wastewater services currently exist and are being replaced from the main to the property line, those services shall be physically located at the property line prior to installing any new mains into which the services will be connected. Where wastewater services currently exist but are not being replaced to the property line, those services shall be physically located at the point of connection between the new and existing pipes prior to installing any new mains into which the services will be connected.

(24) Potable or Reclaimed Water System Connections

All necessary connections of new piping or accessories to the existing potable or reclaimed water system shall be made by, and at the expense of, the Contractor. To minimize any inconvenience from outages, the Contractor shall schedule all such connections in advance and such schedule must be approved by the E/A before beginning any Work.

(a) Shutoffs

The City will make all shutoffs on existing potable or reclaimed water mains. The Contractor shall be required to notify the Owner's Representative in writing a least twenty five (25) Calendar Days prior to the anticipated date for a wet-connection. The Owner's Representative is defined as the City Inspector. The Owner's Representative will notify any affected utility customers at least 48 hours prior to the shutoff. Austin Water (AW) will make the shutoff after ensuring that all appropriate measures have been taken to protect the potable or reclaimed water system, customers and employees.

The City will operate all valves to fill existing mains. Where a newly constructed main has not been placed in service and has only one connection to the potable or reclaimed system, the Contractor may operate one valve to fill the main after approval has been obtained from AW. The operation of the valve is to be conducted under the immediate supervision of the Owner's Representative.

Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

(b) Wet Connections to Existing Potable or Reclaimed Water System

The Contractor shall make all wet connections called for by the Contract or required to complete the Work. Two connections to an existing line performed during the same shutout, at the same time and at a distance less than 50 linear feet apart, will be considered one wet connection. Two connections to an existing line performed during the same shutout, at the same time and at a distance equal to, or greater than 50 linear feet will be considered two wet connections. A wet connection shall include draining and cutting into existing piping and connecting a new pipeline or other extension into the existing pressure piping, forming an addition to the potable or reclaimed water transmission and distribution network.

The Contract price for wet connections shall be full payment for all necessary shutoffs, excavation, removing plugs and fittings, pumping water to drain the lines, cutting in new fittings, blocking and anchoring piping, bedding and backfilling, placing the lines and service and all site cleanup.

No water containing detectable amounts of chlorine may be drained, released or discharged until specific planning and appropriate preparations to handle, dilute and dispose of such chlorinated water are approved in advance by the City and the disposal operations will be witnessed by an authorized representative from the City.

(c) Pressure Taps to Existing Potable or Reclaimed Water System

The Contractor shall make all pressure taps called for by the Contract Documents or required to complete the Work. A pressure tap shall consist of connecting new piping to the existing potable or reclaimed water system by drilling into the existing pipe while it is carrying water under normal pressure without taking the existing piping out of service.

Unless otherwise provided by the Contract, the Contractor shall, at the Contractor's expense, perform all necessary excavation, furnish and install the tapping sleeve, valve and accessories, provide the tapping machine, drill the tap and shall block, anchor and backfill the piping, valve

and all accessories, place the new piping in service and perform all site cleanup. When the City makes the tap, City forces are not obligated or expected to perform any Work except to provide tapping machine and drill the actual hole. If City crews are to make the tap, fiscal arrangements must be made in advance at the Taps Office, Waller Creek Center, 625 East 10th Street.

If a private Contractor makes the tap, an AW Inspector must be present. "Size on size" taps will not be permitted, unless made by use of an approved full bodied mechanical joint tapping sleeve. Concrete blocking shall be placed behind and under all tap sleeves 24 hours prior to making the wet tap.

(d) Service Connections

Service connection taps into PVC or AC pipe or into CI or DI pipe 12 inches or smaller shall be made using either a service clamp or saddle or a tapping sleeve as recommended by the pipe manufacturer and as approved by the E/A. Direct tapping of these pipes will not be permitted.

All potable or reclaimed water service connections shall be installed so that the outlet is at an angle of not more than 45 degrees above horizontal at the main line.

Precautions should be taken to ensure that the tapping saddle or sleeve is placed on the pipe straight to prevent any binding or deformation of the PVC pipe. The mounting chain or U-bolt strap must be tight.

Tapping shall be performed with a sharp shell type cutter so designed that it will smoothly penetrate heavy walled PVC DR14 and 200 psi AC and will retain and extract the coupon from the pipe.

(25) Backfilling

(a) General

Special emphasis is placed upon the need to obtain uniform density throughout the backfill material. The maximum lift of backfill shall be determined by the compaction equipment selected and in no case shall it exceed 18 inches, loose measurement.

No heavy equipment, which might damage pipe, will be allowed over the pipe until sufficient cover has been placed and compacted. All internal pipe bracing installed or recommended by the manufacturer shall be kept in place until the pipe bedding and trench backfill have been completed over the braced pipe section. Testing of the completed backfill in streets and under and around structures shall meet the specified density requirements. Initial testing shall not be at Contractor's expense and shall conform to the "General Conditions."

(b) General Corrugated Metal Pipe

After the corrugated metal pipe structure has been completely assembled on the proper line and grade and headwalls constructed where indicated; selected material free from rocks over 8 inches in size from excavation or borrow, as approved by the E/A, shall be placed along both sides of the completed structures equally, in uniform layers not exceeding 6 inches in depth (loose measurement), sprinkled if required and thoroughly compacted between adjacent structures and between the structures and the sides of the trench.

Backfill material shall be compacted to the same density requirements as indicated for the adjoining sections of embankment in accordance with the governing specifications thereof. Above the $\frac{3}{4}$ point of the structure, the fill shall be placed uniformly on each side of the pipe in layers not to exceed 12 inches, loose measure.

Prior to adding each new layer of loose backfill material, until a minimum of 12 inches of cover is obtained over the crown of the pipe, an inspection will be made of the inside periphery of the

corrugated metal structure to determine if any floating, local or unequal deformation has occurred as a result of improper construction methods.

(c) Backfill Materials

The Engineer or designated representative may approve any of the following well graded materials as backfill:

1. Select trench material
2. Sand
3. Crushed rock cuttings
4. Rock cuttings
5. Foundation Rock
6. Blasted material with fines and rock
7. Cement stabilized material
8. Borrow

Within the 100-year flood plain, sand will not be permitted for backfilling. The Engineer or designated representative will approve the topsoil for areas to be seeded or sodded.

(d) Backfill in Street Right-of-Way

Placement of backfill under existing or future pavement structures and within 2 feet of any structures shall be compacted to the specified density using any method, type and size of equipment, which will produce the specified compaction without damaging the pipe or bedding. Placement of backfill greater than 2 feet beyond structures in right-of-way shall conform to (g) below.

The thickness of lifts, prior to compaction, shall depend upon the type of sprinkling and compacting equipment used and the test results thereby obtained. Prior to and in conjunction with the compaction operation, each lift shall be brought to the moisture content necessary to obtain the specified density and shall be placed in a uniform thickness to ensure uniform compaction over the entire lift. Testing for density shall be in accordance with Test Method Tex-114-E and Test Method Tex-115-E.

It is highly desirable that the backfill lifts be placed in a flat (or level) configuration; however when approved by the Engineer or designated representative, the backfill lifts may be placed at gradients (percent of vertical rise or fall to horizontal run) that do not exceed 30%.

The proposed gradient for each lift or series of lifts shall be established based on the capabilities of the equipment proposed to attain the required compaction.

Each lift of backfill must provide the density as specified herein. Swelling soils (soils with a minimum Liquid Limit of 50, more than 50% passing a #200 sieve and a plasticity index greater than 22) shall be sprinkled as required to provide not less than optimum moisture nor more than 2 percent over optimum moisture content and compacted to the extent necessary to provide not less than 95 percent nor more than 102 percent of the density as determined in accordance with Test Method Tex-114-E. Non-swelling soils shall be sprinkled as specified and compacted to the extent necessary to provide not less than 95 percent of the density as determined in accordance with Test Method Tex-114-E.

After each lift of backfill is complete, tests may be made by the Engineer or designated representative. If the material fails to meet the density indicated, the course shall be reworked

as necessary to obtain the indicated compaction and the compaction method shall be altered on subsequent Work to obtain indicated density.

At any time, the Engineer or designated representative may order proof rolling to test the uniformity of compaction of the backfill lifts. All irregularities, depressions, weak or soft spots that develop shall be corrected immediately by the Contractor.

If the backfill, due to any reason, loses the specified stability, density or finish before the pavement structure is placed, it shall be recompacted and refinished at the sole expense of the Contractor. Excessive loss of moisture in the subgrade shall be prevented by sprinkling, sealing or covering with a subsequent backfill layer or granular material. Excessive loss of moisture shall be construed to exist when the subgrade soil moisture content is more than 4 percent below the optimum of compaction ratio density. Backfill shall be placed from the top of the bedding material to the existing grade, base course, subgrade or as specified. The remainder of the street backfill shall either be Flexible Base, Concrete or Hot Mix Asphalt Concrete as specified on the drawings or replacement "in kind" to the surface of the materials originally removed for placement of the pipe.

(e) Backfill in County Street or State Highway Right-of-Way

All Work within the right-of-way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the County when their requirements are more stringent. Prior to the start of construction, the Contractor shall be responsible for contacting the appropriate TxDOT office or County Commissioner's Precinct Office and following the operating procedures in effect for utility cut permits and pavement repair under their jurisdiction. Approval for all completed Work in the State or County right-of-way shall be obtained from the appropriate Official prior to final payment by the Owner.

(f) Backfill in Railroad Right-of-Way

All Work within the railroad right-of-way shall meet the requirements of (d) above, as a minimum and shall meet the requirements of the permit issued by the Railroad Owner when their requirements are more stringent. Approval for all completed Work in the railroad right of way shall be obtained from the Railroad prior to Final Completion.

(g) Backfill in Easements

Where not otherwise indicated, Contractor may select whatever methods and procedures may be necessary to restore entire Work area to a safe, useful and geologically stable condition with a minimum density of 85 percent or a density superior to that prior to construction.

In and near flood plain of all streams and watercourses, under or adjacent to utilities, structures, etc. all backfill shall be compacted to a density of not less than 95 percent conforming to TxDOT Test Method Tex-114-E, unless otherwise directed by E/A.

All soil areas disturbed by construction shall be covered with top soil and seeded conforming to Item No. 604, "Seeding for Erosion Control". All turf, drainways and drainage structures shall be constructed or replaced to their original condition or better. No debris shall remain in the drainways or drainage structures.

(h) Temporary Trench Repair/Surfacing

If details of temporary trench repair/surfacing are not provided in the contract documents, the Contractor shall submit for approval of the E/A (1) a plan for temporary trench repair for areas that will be open to traffic but will be excavated later for full depth repair, and (2) a proposed method for covering trenches to maintain access to properties. The temporary surfacing shall

afford a smooth riding surface and shall be maintained by the Contractor the entire time the temporary surface is in place.

(i) Permanent Trench Repair

The Contractor shall install permanent trench repairs conforming to details in the drawings.

(26) Quality Testing for Installed Pipe

(a) Wastewater Pipe Acceptance Testing

After wastewater pipe has been backfilled, the Contractor shall perform infiltration tests, exfiltration tests, or low pressure air tests as determined by the E/A. In addition, the Contractor shall perform deflection tests and shall assist OWNER'S personnel, as directed, in performing pipeline settlement tests. The Contractor shall be responsible for making appropriate repairs to those elements that do not pass any of these tests.

(b) Exfiltration Test

Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

Exfiltration testing shall be performed by the Contractor when determined by the E/A to be the appropriate test method. Exfiltration testing shall conform to requirements of the Texas Commission on Environmental Quality given in the Texas Administrative Code Title 30 Part 1 Chapter 317 Rule §317.2.

(c) Infiltration Test

Infiltration testing shall be performed by the Contractor when determined by the E/A to be the appropriate test method. Infiltration testing shall conform to requirements of the Texas Commission on Environmental Quality given in the Texas Administrative Code Title 30 Part 1 Chapter 317 Rule §317.2.

(d) Pipeline Settlement Test

During the infiltration test or after the exfiltration test, the pipe will be TV inspected for possible settlement. When air testing has been used, water shall be flowed into the pipe to permit meaningful observations. Any pipe settlement which causes excessive ponding of water in the pipe shall be cause for rejection. Excessive ponding shall be defined as a golf ball (1 5/8" dia.) submerged at any point along the line.

(e) Low Pressure Air Test of Gravity Flow Wastewater Lines

(1) General

Wastewater lines up to 33-inch diameter shall be air tested between manholes.

Wastewater lines 36-inch in diameter and larger shall be either air tested between manholes or at pipe joints. Backfilling to grade shall be completed before the test and all laterals and stubs shall be capped or plugged by the Contractor so as not to allow air losses, which could cause an erroneous, test result. Manholes shall be plugged so they are isolated from the pipe and cannot be included in the test.

All plugs used to close the sewer for the air test shall be capable of resisting the internal pressures and must be securely braced. Place all air testing equipment above ground and allow no one to enter a manhole or trench where a plugged sewer is under pressure. Release all pressure before the plugs are removed. The testing equipment used must include a pressure relief device designed to relieve pressure in the sewer under test at 10 psi or less and must allow continuous monitoring of the test pressures in order to avoid

excessive pressure. Use care to avoid the flooding of the air inlet by infiltrated ground water. (Inject the air at the upper plug if possible.) Use only qualified personnel to conduct the test.

(2) Ground Water

Since the presence of ground water will affect the test results, test holes shall be dug to the pipe zone at intervals of not more than 100 feet and the average height of ground water above the pipe (if any) shall be determined before starting the test.

(3) Test Procedure

The E/A may, at any time, require a calibration check of the instrumentation used. Use a pressure gauge having minimum divisions of 0.10 psi and an accuracy of 0.0625 psi. (One ounce per square inch.) All air used shall pass through a single control panel. Clean the sewer to be tested and remove all debris where indicated. Wet the sewer prior to testing. The average back pressure of any groundwater shall be determined (0.433 psi) for each foot of average water depth (if any) above the sewer.

Add air slowly to the section of sewer being tested until the internal air pressure is raised to 3.5 psig greater than the average back pressure of any ground water that may submerge the pipe. After the internal test pressure is reached, allow at least 2 minutes for the air temperature to stabilize, adding only the amount of air required to maintain pressure. After the temperature stabilization period, disconnect the air supply. Determine and record the time in seconds that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig greater than the average backpressure of any ground water that may submerge the pipe.

For pipe less than 36-inch diameter, compare the time recorded with the time computed using the following equation:

$$T = (0.0850 \times D \times K) \div Q, \text{ where}$$

T = time for pressure to drop 1.0 pounds per square inch gauge in seconds;

K = $0.000419 \times D \times L$, but not less than 1.0

D = nominal inside diameter, in inches, as marked on the pipe;

L = length of line of same pipe size in feet; and

Q = rate of loss, 0.0015 cubic feet per minute per square foot of internal surface area (ft³/min/ft sq) shall be used.

Because a K value of less than 1.0 shall not be used, there are minimum test times for each pipe diameter as shown in the following table:

Table For Low Pressure Air Testing of Pipe

Pipe Diameter (inches)	Minimum Time (seconds)	Minimum Time Applies to All Pipes Shorter than (feet)	Time for Longer Pipes (seconds)
8	454	298	$1.520 \times L$
10 (See Note 1)	567	239	$2.374 \times L$
12	680	199	$3.419 \times L$
15	850	159	$5.342 \times L$
18	1020	133	$7.693 \times L$

21	1190	114	$10.471 \times L$
24	1360	100	$13.676 \times L$
30	1700	80	$21.369 \times L$

Note 1. 10-inch diameter pipe to be used only by AW maintenance personnel.

Note 2. The test parameter for pipes larger than 30-inch diameter shall be shown on the construction plans.

Any drop in pressure, from 3.5 psig to 2.5 psig (adjusted for groundwater level), in a time less than that required by the above equation or table shall be cause for rejection. When the line tested includes more than one size pipe, the minimum time shall be that given for the largest size pipe included.

When joint testing, the minimum time allowable for the pressure to drop from 3.5 pounds per square inch to 2.5 pounds per square inch gauge during a joint test, regardless of pipe size, shall be twenty (20) seconds. A drop in pressure from 3.5 psig to 2.5 psig (adjusted for groundwater level) in less than twenty seconds shall be cause for rejection.

Manholes must be tested separately and independently. All manholes must be hydrostatically tested with a maximum loss allowance of 0.025 gallon per foot diameter per foot of head per hour.

When lines are air tested, manholes are to be tested separately by exfiltration or vacuum method (see Standard Specification Item No. 506S, "Manholes").

(f) Deflection Test

Deflection tests shall be performed by the Contractor on all flexible and semi-rigid wastewater pipes. The tests shall be conducted after the final backfill has been in place at least 30 days. Testing for in-place deflection shall be with a pipe mandrel at 95% of the inside diameter of the pipe. A second test of flexible and semi-rigid wastewater pipes 18 inch size and larger, also with a pipe mandrel sized at 95% of the inside diameter of the pipe, shall be conducted by the Contractor 30 days before the warranty expires on the Contractor's Work.

Contractor shall submit proposed pipe mandrels to the E/A or the E/A's designated representative for concurrence prior to testing the line.

Test(s) must be performed without mechanical pulling devices and must be witnessed by the E/A or the E/A's designated representative.

Any deficiencies noted shall be corrected by the Contractor and the test(s) shall be redone.

(g) Inspection of Installed Storm Drain Conduits

(1) General

All storm drain conduits (pipe and box culvert) shall be inspected for conformance to the requirements of this specification. Smart Housing, low/moderate income housing, and projects that are 100-percent privately funded are exempt from the cost of the initial video inspection. All deficiencies revealed by inspection shall be corrected. Video re-inspection meeting the requirements of this specification shall be provided at the Contractor's expense to show that deficiencies have been corrected satisfactorily. Further, the contractor shall provide video in complete segments (manhole to manhole) versus specific deficiency locations.

Projects that are not exempt from the cost of the initial video inspection are also subject to the following constraints:

- All inspectors utilized by the Contractor for video inspection shall be NASSCO-PACP certified for a minimum of 3 years.
- The Contractor will be required to inspect, assess, and record the condition of the storm drain pipe using National Association of Sewer Service Companies (NASSCOs) Pipeline Assessment Certification Program (PACP) coding standards.

(2) Video Inspection of Installed Storm Drain Conduits

Contractor shall provide all labor, equipment, material and supplies and perform all operations required to conduct internal closed-circuit television and video recording of all storm drain conduits. Video recording of each storm drain conduit section shall be conducted after the trench has been backfilled and prior to placement of permanent pavement repairs or permanent pavement reconstruction. The video recording shall be provided to the Owner for review. Contractor shall not place permanent pavement repairs or permanent pavement reconstruction over the storm drain conduit until Owner has reviewed the video and agrees that there are no defects in the storm drain conduit installation shown in the video submitted by the Contractor or shown in any video acquired by the Owner through other means. Placement of permanent pavement repair or permanent pavement reconstruction over the installed storm drain conduit before the Owner acknowledges no defects shall be at the Contractor's risk. Any defects revealed by the video inspection shall be corrected at the Contractor's expense and a new video submitted to the Owner for review prior to acceptance of the conduit.

All video work shall be conducted under the direct full-time supervision of a NASSCO-PACP certified operator.

The conduit inspection camera shall have the capability of panning plus/minus 275 degrees and rotating 360 degrees. The television camera shall be specifically designed and constructed for such use. The camera shall be operative in 100% humidity conditions. Camera shall have an accurate footage counter that displays on the monitor the exact distance of the camera (to the nearest tenth of a foot) from the centerline of the starting manhole or access point. Camera shall have height adjustment so that the camera lens is always centered within plus/minus 10% of the center axis of the conduit being videoed. Camera shall provide a minimum of 460 lines of horizontal resolution and 400 lines of vertical resolution. Camera shall be equipped with a remote iris to control the illumination range for an acceptable picture. Geometrical distortion of the image shall not exceed one percent (1%). The video image produced by each camera shall be calibrated using a Marconi Resolution Chart No. 1 or equivalent.

Lighting for the camera shall be sufficient to allow a clear picture of the entire periphery of the conduit without loss of contrast, flare out of picture or shadowing. A reflector in front of the camera may be required to enhance lighting in dark or large sized conduit. The video camera shall be capable of showing on the digital display the Owner's name, Project name, Contractor name, date, line size and material, conduit identification, and ongoing footage counter. The camera, television monitor, and other components of the video system shall be capable of producing a picture quality satisfactory to the satisfaction of the Owner. The recording of the internal condition of the storm drain conduit shall be clear, accurate, focused and in color. If the recording fails to meet these requirements, the equipment shall be removed and replaced with equipment that is suitable. No payment will be made for an unsatisfactory recording.

If during video inspection, water is encountered inside the conduit, the conduit shall be dewatered by the Contractor. The storm drain section must be dry. Video recording conducted while the camera is floating is not acceptable unless approved by the Owner.

If during video inspection, debris is encountered that prohibits a proper inspection of the conduit, the Contractor shall remove the debris before proceeding.

All video shall be documented using a data logger and reporting system that are PACP compliant and which use codes as established by the National Association of Sewer Service Companies (NASSCO)s - Pipeline Assessment and Certification Program (PACP).

Computer printed location records shall be kept by the Contractor and shall clearly show the location and orientation of all points of significance such as joints, conduit connections, connections at manholes and inlets, and defects. Copy of all records shall be supplied to the Owner. Noted defects shall be documented as color digital files and color hard copy print-outs. Photo logs shall accompany each photo submitted.

The video recording shall supply a visual and audio record of the storm drain conduits that may be replayed. Video recordings shall include an audio track recorded by the video technician during the actual video work describing the parameters of the storm drain conduit being videoed (i.e. location, depth, diameter, pipe material), as well as describing connections, defects and unusual conditions observed during the video work. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor. Once videoed, the CDs/DVDs shall be labeled and become the property of the Owner. The Contractor shall have all video and necessary playback equipment readily accessible for review by the Owner while the project is under construction.

Post-installation video shall not be completed until all work is completed on a section of storm drain conduit. Post-installation video work shall be completed by the Contractor in the presence of the Owner. The post-installation video work shall be completed to confirm that the storm drain conduits are free of defects. Provide a color video showing the completed work. Prepare and submit video logs providing location of storm drain conduit along with location of any defects. Manhole and inlet work shall be complete prior to post-installation video work.

For post-installation video, exercise the full capabilities of the camera equipment to document the completion and conformance of the storm drain installation work with the Contract Documents. Provide a full 360-degree view of conduit, all joints, and all connections. The camera shall be moved through the storm drain conduit in either direction at a moderate rate, stopping and slowly panning when necessary to permit proper documentation of the conduit condition at each pipe connection, joint, and defect. In no case shall the camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interfere with proper documentation of the storm drain conditions shall be used to move the camera through the storm drain conduit. When manually operated winches are used to pull the camera through the conduit, telephones or other suitable means of communication shall be set up between the two access points of the conduit being videoed to insure good communication between members of the video crew.

Distance measurements shall be provided to an accuracy of one tenth of a foot.

Video shall be continuous for each storm drain conduit segment. Do not show a single segment on more than one CD/DVD, unless specifically allowed by the Owner.

Contractor shall submit to Owner the following:

- A. National Association of Sewer Service Companies (NASSCO) Pipeline Assessment and Certification Program (PACP) certification of operators who will be performing video work.
 - B. Compact Disc (CD) or Digital Video Disc (DVD) of recording of storm drain conduits (concrete storm water pipe or box culvert).
 - a. The color CD or DVD shall include a digital color key map in a format acceptable to the Owner with each segment of storm drain conduit labeled with the appropriate inspection ID on the map.
 - b. The file folder for each segment of the storm drain conduit shall have a unique name based on the Owner's approved inspection naming convention and shall contain the following:
 - i. Video files
 - ii. Video inspection logs with information coded in accordance with the PACP
 - iii. Photo logs
 - iv. A report summarizing the results of the video inspection
 - v. A proposed method of repair for any defects discovered.
- (3) Time commitments from City for projects that are exempt from the cost of the initial video inspection

Projects that are exempt from the cost of the initial video inspection are afforded the following time commitments from the City.

- A. Initial inspection - contractor must inform the City of Austin construction inspector assigned to the project in writing that all stormdrain infrastructure for the project has been completed according to the permit and is ready for inspection. The inspector will then notify the Watershed Protection Department (WPD) in writing that the all of the stormdrain infrastructure for the project has been completed and is ready for inspection. The WPD is allowed 15-days to complete inspection from written notification by the inspector. The outcome of this item does not impact the one-year warranty requirements.
- B. Video re-inspection by the contractor for deficient installed stormdrain infrastructure. The contractor must submit the video inspection data as defined in this specification to the City of Austin construction inspector assigned to the project along with a written letter of transmittal certified by a professional engineer stating that all identified stormdrain infrastructure installation deficiencies for the project have been corrected. The inspector will then notify the Watershed Protection Department (WPD) in writing and convey the video inspection data to the WPD. The WPD is allowed 15-days to complete review of the data from the date of delivery by the inspector.

(27) Pressure Pipe Hydrostatic Testing

After the pipe has been installed and backfilled and all service laterals, fire hydrants and other appurtenances installed and connected, a pressure test, followed by a leakage test, will be conducted by the City. The City will furnish the pump and gauges for the tests. The Contractor shall be present and

shall furnish all necessary assistance for conducting the tests. The specified test pressures will be based on the elevation of the lowest point of the line or section under test. Before applying the specified test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points.

All drain hydrant and fire hydrant leads, with the main 6-inch gate valve open, the hydrant valve seats closed and no nozzle caps removed, shall be included in the test.

(a) Pressure Test

The entire project or each valved section shall be tested, at a constant pressure of 200 psi for a sufficient period (approximately 10 minutes) to discover defective materials or substandard work. The Contractor assumes all risks associated with testing against valves. Repairs shall be made by the Contractor to correct any defective materials or substandard work. The Contractor shall pre-test new lines before requesting pressure tests by City Forces. The Contractor shall have new lines pressurized to a minimum of 100 psi, on the date of testing, prior to arrival of City Forces.

(b) Leakage Test

A leakage test will follow the pressure test and will be conducted on the entire project or each valved section. The Contractor assumes all risks associated with testing against valves. The leakage test shall be conducted at 150 psi for at least 2 hours. The test pressure shall not vary by more than ± 5 psi for the duration of the test.

(1) Allowable Leakage

Leakage shall be defined as the quantity of water that must be supplied into any test section of pipe to maintain the specified leakage test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

No pipe installation will be accepted if leakage exceeds the amount given by the following formula:

$$\text{Allowable leakage (gal/hr)} = [L \times D] \div 10,875$$

Where L = length of pipe tested, in feet

D = nominal pipe diameter, in inches, as marked on the pipe

(2) Location and Correction of Leakage

If such testing discloses leakage in excess of this specified allowable, the Contractor, at the Contractor's expense, shall locate and correct all defects in the pipeline until the leakage is within the indicated allowance.

All visible leakage in pipe shall also be corrected by Contractor at the Contractor's expense.

(28) Service Charges for Testing

Initial testing performed by City forces for the Contractor will be at the City's expense. Retesting, by City forces, of Contractor's work that fails initial testing will be at the Contractor's expense. The City's charge for retests will be a base fee plus an hourly rate published in the current AW Fee Schedule. On City-funded projects, the charges incurred by the City for retesting will be deducted from funds due the Contractor. On non-City-funded projects, the charges incurred by the City for retesting will be billed to the Contractor. The City will withhold acceptance of the Contractor's work until the Contractor has paid the City for the retesting costs.

(29) Disinfection of Potable Water Lines

Prior to performing any disinfection of potable water lines, the Contractor shall submit a Disinfection Plan (Plan) and obtain approval in accordance with COA specification 01300, Submittals. The Plan shall comply with AWWA C651 (Disinfecting Water Mains) and AWWA C655 (Field Dechlorination), latest editions, and shall be developed using one of the following templates, unless otherwise approved by the Engineer and/or AW: Disinfection Plan for Tablet/Granule Method, or Disinfection Plan for Continuous-Feed Method. Templates for these two methods are located at <http://www.austintexas.gov/department/construction-standards> . The Contractor shall decide which disinfection method to use for a given project. The Slug Method and Spray Method are also acceptable if better suited for disinfection. The initial plan shall be submitted for review a minimum of 60 calendar days prior to when the water main is scheduled to be placed into service, or at the preconstruction conference if the project requires that the waterline be placed in service in less than 60 days, as indicated in the Contractor's Construction Schedule. If any appurtenances are required for injection, sampling, or flushing purposes that are not shown in the original plan/profile sheets, then the Contractor shall include the appurtenances in the project Record Drawings. The Contractor shall disinfect potable water lines only in accordance with an approved Plan.

(a) Preventing Contamination

The Contractor shall protect all piping materials from contamination during storage, handling and installation. Prior to disinfection, the pipeline interior shall be clean, dry and unobstructed. All openings in the pipeline shall be closed with watertight plugs when pipe laying is stopped at the close of the day's work.

(b) Cleaning

Prior to disinfection the Contractor shall clean the pipeline to remove foreign matter. For pipelines 16" in diameter or smaller, cleaning shall consist of flushing the pipeline. For pipelines greater than 16" in diameter, cleaning shall be performed by operating hydrants and blow-offs located at low points in the pipeline, or by mechanical means (sweeping or pigging). Water for the Work shall be metered and furnished by the Contractor in accordance with Section 01500 of the Standard Contract Documents.

(c) Procedure and Dosage

For pipelines 16" or smaller in diameter, the Contractor may use either the AWWA C-651 "Tablet/Granular Method" or the "Continuous Feed Method" for disinfecting the pipeline. The Contractor, at its expense, will supply the test gauges and the Sodium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 5 percent to fifteen percent available chlorine, and will submit for approval a written plan for the disinfection process. Calcium Hypochlorite conforming to ANSI/AWWA B300, which contains approximately 65 percent available chlorine by weight, may be used in granular form or in 5 g tablets for 16" diameter or smaller lines, if it is included as part of the written plan of disinfection that is approved by the City of Austin. The Contractor, at its expense, shall provide all other equipment, supplies and the necessary labor to perform the disinfection under the general supervision of the City.

One connection to the existing system will be allowed with a valve arranged to prevent the strong disinfecting dosage from flowing back into the existing water supply piping. The valve shall be kept closed and locked in a valve box with the lid painted red. No other connection shall be made until the disinfection of the new line is complete and the water samples have met the established criteria. The valve shall remain closed at all times except when filling or flushing the line and must be staffed during these operations. As an option, backflow prevention in the form of a reduced pressure backflow assembly may be provided if the valve is left unattended. The new pipeline shall be filled completely with disinfecting solution by feeding the concentrated chlorine and approved water from the existing system uniformly into the new piping in such

proportions that every part of the line has a minimum concentration of 25 mg/liter available chlorine.

The disinfecting solution shall be retained in the piping for at least 16 hours and all valves, hydrants, services, stubs, etc. shall be operated so as to disinfect all their parts. After this retention period, the water shall contain no less than 10 mg/liter chlorine throughout the treated section of the pipeline.

For pipelines larger than 16" in diameter, the Contractor may use the AWWA C-651 "Slug Method" for disinfecting the pipeline. Chlorine shall be fed at a constant rate and at a sufficient concentration at one end of the pipeline to develop a slug of chlorinated water having not less than 100 mg/liter of free chlorine. The Contractor shall move the slug through the main so that all interior surfaces are exposed to the slug for at least three (3) hours. The chlorine concentration in the slug shall be measured as it moves through the pipeline. If the chlorine concentration drops below 50 mg/liter, the Contractor shall stop the slug and feed additional chlorine to the head of the slug to restore the chlorine concentration to at least 100 mg/liter before proceeding. As the slug flows past fittings and valves, related valves and hydrants shall be operated so as to disinfect appurtenances and pipe branches.

Unless otherwise indicated, all quantities specified herein refer to measurements required by the testing procedures included in the current edition of "Standard Methods". The chlorine concentration at each step in the disinfection procedure shall be verified by chlorine residual determinations.

(d) Final Flushing

The heavily chlorinated water shall then be carefully flushed from the potable water line by a dechlorination process until the chlorine concentration is no higher than the residual generally prevailing in the existing distribution system. This is necessary to insure that there is no injury or damage to the public, the water system or the environment. The plans and preparations of the Contractor must be approved by the City before flushing of the line may begin. The Contractor will supply the Dechlorination chemical conforming to ANSI/AWWA C655. Additionally the flushing must be witnessed by an authorized representative of the City.

Approval for discharge of the diluted chlorine water or heavily chlorinated water into the wastewater system must be obtained from AW. The line flushing operations shall be regulated by the Contractor so as not to overload the wastewater system or cause damage to the odor feed systems at the lift stations. The City shall designate its own representative to oversee the work.

Daily notice of line discharging must be reported to the AW Dispatch office.

(e) Bacteriological Testing

After disinfection and final flushing, samples shall be collected per one of the two options. Option A: Before approving a main for release, take an initial set of samples and then resample again after a minimum of 16 hours. Both sets of samples must pass for the main to be approved for release. Option B: Before approving a main for release, let it sit for a minimum of 16 hours without any water use. Then collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running. Both sets of samples must pass for the main to be approved for release. The two (2) sets of water samples from the line will be tested for bacteriological quality by the City and must be found free of coliform organisms before the pipeline may be placed in service. Each set shall consist of one (1) sample that is drawn from the end of the main, at least one from each branch greater than one pipe length, and additional samples that are collected at intervals of not more than 1,200 feet along the pipeline. All stubs shall be tested before connections are made to existing systems.

The Contractor, at its expense, shall install sufficient sampling taps at proper locations along the pipeline. Each sampling tap shall consist of a standard corporation cock installed in the line and extended with a copper tubing gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.

Samples for bacteriological analysis will only be collected from suitable sampling taps in sterile bottles treated with sodium thiosulfate. Samples shall not be drawn from hoses or unregulated sources. The City, at its expense, will furnish the sterile sample bottles and may, at its discretion, collect the test samples with City personnel.

If the initial disinfection fails to produce acceptable sample test results, the disinfection procedure shall be repeated at the Contractor's expense. Before the piping may be placed in service, two (2) consecutive sets of acceptable test results must be obtained.

An acceptable test sample is one in which: (1) the chlorine level is similar to the level of the existing distribution system; (2) there is no free chlorine and (3) total coliform organisms are absent. An invalid sample is one, which has excessive free chlorine, silt or non-coliform growth as defined in the current issue of the "Standards Methods." If unacceptable sample results are obtained for any pipe, the Contractor may, with the concurrence of the Inspector, for one time only flush the lines and then collect a second series of test samples for testing by the City. After this flushing sequence is completed, any pipe with one or more failed samples must be disinfected again in accordance with the approved disinfection procedure followed by appropriate sampling and testing of the water.

The City of Austin Water Quality Laboratory will notify the assigned City of Austin Inspector in writing of all test results. The Inspector will subsequently notify the Contractor of all test results. The Water Quality Laboratory will not release test results directly to the Contractor.

(30) Cleanup and Restoration

It shall be the Contractor's responsibility to keep the construction site neat, clean and orderly at all times. Cleanup shall be vigorous and continuous to minimize traffic hazards or obstructions along the streets and to driveways. Trenching, backfill, pavement repair (as necessary), and cleanup shall be coordinated as directed by the City. The E/A will regulate the amount of open ditch and may halt additional trenching if cleanup is not adequate to allow for orderly traffic flow and access.

Materials at the site shall be stored in a neat and orderly manner so as not to obstruct pedestrian or vehicular traffic. All damaged material shall be removed from the construction site immediately and disposed of in a proper manner. All surplus excavated materials shall become the property of the Contractor for disposal at the Contractor's expense. After trenching, the Contractor shall immediately remove all excavated materials unsuitable for or in excess of, backfill requirements. Immediately following the pipe laying Work as it progresses, the Contractor shall backfill, grade and compact all excavations as provided elsewhere. The backfill placed at that time shall meet all compaction test requirements. The Contractor shall immediately clean up and remove all unused soil, waste and debris and restore all surfaces and improvements to a condition equal or superior to that before construction began and to an appearance which complements the surroundings. The Contractor shall grade and dress the top 6 inches of earth surfaces with soil or other material similar and equal to the surrounding, fill and smooth any visible tracks or ruts, replace and re-establish all damaged or disturbed turf or other vegetation and otherwise make every effort to encourage the return of the entire surface and all improvements to a pleasant appearance and useful condition appropriate and complementary to the surroundings and equal or similar to that before construction began.

Placement of the final lift of permanent pavement, if a pavement is required, shall begin immediately after all testing of each segment of piping is satisfactorily completed.

(31) Valve Turn Walk-through

As part of the acceptance of Water or Reclaimed Water pressure pipe, an AW Valve Walk-through will be performed after an initial inspection by the Owner's Representative to identify any deficient items. If deficient items are present during the AW Valve Walk-Through and the project fails acceptance, a re-inspection fee will apply and must be paid before a re-inspection is scheduled to confirm correction of deficient items. See AW Fee Schedule for the current Distribution Walk-Through Re-inspection Fee.

(32) 2-inch Jumper Hose

During connections to the water distribution system, the Contractor may be required to install a temporary jumper hose between the unpressurized water segment and an adjacent pressurized water segment for the purpose of maintaining water service to customers who can't operate without water service during the connection. The jumper shall include an approved backflow preventer and be of adequate size and pressure rating to maintain service to the customer. It shall be polyethylene tubing meeting the requirements of COA SPL WW-65. The jumper hose and other components in the temporary service shall be disinfected, and bacteriological samples will be taken and pass before the temporary service is provided to the customer. Contractor shall provide adequate protection for the jumper hose in vehicular traffic areas at all times during use.

Source: Rule No. R161-17.05 , 5-31-2017; Rule No. R161-17.19 , 11-28-2017; Rule No. R161-18.23 , 12-8-2018.

510.4 Measurement

Pipe will be measured by the linear foot for the various types, sizes and classes. Parallel lines will be measured individually.

Where a line ties into an existing system, the length of the new line will be measured from the visible end of the existing system at the completed joint. Unless otherwise indicated, the length of water, reclaimed, and wastewater lines will be measured along pipe horizontal centerline stationing through fittings, valves, manholes, and other appurtenances.

Ductile iron fittings, whether standard mechanical joint or integral factory restrained joint type, will be measured by the ton and paid for in accordance with the schedule in Standard Products List WW-27C. Bolts, glands and gaskets will not be measured for payment. Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be measured separately and are included in the unit price for the respective pipe bid items.

Factory restrained joint pipe meeting the requirements of Standard Products List WW-27F will be measured by the linear foot. The estimated quantity on the bid form is only for restrained joint pipe having integral mechanically restrained joints.

Connecting a new water, wastewater, or reclaimed water service to an existing, comparable type of private service will be measured by each connection. Service pipe from the main to the service connection will be measured by the linear foot.

The Contractor shall be responsible for removing and treating ground water flowing into a trench up to a baseline flow rate of 350 gpm of sustained flow for each mainline open trench (no more than 300 linear feet open trench per work zone segment is allowed at one time). This baseline flow rate is not a prediction of ground water conditions to be expected on the Project. Rather, it establishes contract terms regarding the quantity of ground water for which the contractor is responsible without extra or separate compensation. The flow rate must exceed 350 gpm continuously for at least 4 consecutive hours to be considered sustained flow. It is expected that trench dewatering for this baseline rate may be accomplished with a single 3-inch trash-type pump per open trench;

however, measured flow rate, not pump size, type or characteristics shall be used to determine if the baseline rate has been exceeded. Flow rate shall be determined by measurements made at the discharge point of the water treatment facilities. Surface storm water flowing into a trench shall be the Contractor's responsibility to remove and treat without compensation, regardless of inflow rate or volume.

Adjustment of elevations during construction resulting in changes in flow line elevations of plus or minus two feet or less will not be considered for credit or additional compensation and no measurement for payment will be made.

Stormwater pipe will be measured along the slope of the pipe. Where drainage pipe ties into inlets, headwalls, catch basins, manholes, junction boxes or other structures that length of pipe tying into the structure wall will be included for measurement but no other portion of the structure length or width will be so included.

Excavation and backfill, when included as pipe installation will not be measured as such but shall be included in the unit price bid for constructing pipe and measured as pipe complete in place including excavation and backfill.

When pay items are provided for the other components of the system, measurement will be made as addressed hereunder.

Video inspection of newly installed box culverts and storm drain pipe will be measured per linear foot of pipe videoed.

Jumper hose will be measured per linear foot of hose installed, including all depths, excavation and backfill, complete, and in place.

Source: Rule No. R161-17.05 , 5-31-2017.

510.5 Payment

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot for the various sizes of pipe, of the materials and type indicated, unless unstable material is encountered or trench excavation and backfill is bid as a separate item.

The concrete seal, foundation rock or coarse aggregate when used as directed in unstable material will be paid for at the unit price bid per cubic yard, which shall be full payment for all excavation and removal of unsuitable material and furnishing, placing and compacting the foundation rock, coarse aggregate or other approved material all complete in place.

Excavation and backfill, when included as a separate pay item, will be paid for by Pay Item No. 510-E or 510-F.

No separate payment will be made for dewatering a trench with ground water inflow of less than the baseline rate of 350 gpm of sustained flow as described above. Dewatering of those trenches shall be included in the contract unit price of the Pipe pay item. Payment for dewatering a trench with ground water inflow exceeding 350 gpm of sustained flow shall be agreed by change order. Dewatering of bore pits shall be included in the contract unit price for Bore Entry Pit or Exit Pit regardless of inflow rate or volume unless specified otherwise in the bid item for Bore Entry Pit or Exit Pit.

(1) Pipe

Payment for pipe, measured as prescribed above, will be made at the unit price bid per linear foot complete-in-place as designed and represented in the Drawings and other Contract documents. Restrained joint pipe meeting the requirements of Standard Products List WW-27F will be paid for separately at the unit price bid per linear foot. Unless otherwise provided herein, as separate pay item(s), the bid price per linear foot of pipe shall include the following:

- a. clearing

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- b. constructing any necessary embankment
 - c. excavation
 - d. disposal of surplus or unusable excavated material
 - e. furnishing, hauling and placing pipe
 - f. field constructed joints, collars, temporary plugs, caps or bulkheads
 - g. all necessary lugs, rods or braces
 - h. pipe coatings and protection
 - i. connections to existing systems or structures, concrete blocking and thrust blocks and restrained joints
 - j. preparing, shaping, pumping for dewatering, and shoring of trenches
 - k. bedding materials
 - l. backfill materials
 - m. hauling, placing and preparing bedding materials
 - n. particle migration measures
 - o. hauling, moving, placing and compacting backfill materials
 - p. temporary and permanent pavement repairs and maintenance
 - q. temporary removal and replacement of pavement, curb, drainage structures, driveways, sidewalks and any other improvements damaged or removed during construction
 - r. cleanup
 - s. vertical stack on deep wastewater services
 - t. all other incidentals necessary to complete the pipe installation as indicated.
 - u. pipe joint restraint devices, where specified or allowed, meeting Standard Products List WW-27A or WW-27G.

No separate payment will be made for thrust restraint measures.

Steel cylinder concrete pipe fittings and welded steel pipe fittings will not be paid for separately. These will be included in the unit price bid for the bid item Pipe.

(2) Concrete Cradles and Seals

When called for in the Bid, concrete cradles and seals will be paid for at the unit Contract price bid per linear foot for the size of pipe specified, complete in place.

(3) Concrete Retards

When called for in the Bid, Concrete retards will be paid under Item No. 593S, Concrete Retards."

(4) Boring or Jacking.

When called for in the Bid, boring or jacking will be paid under Item 501S, "Jacking or Boring Pipe.

(5) Wet Connections to Potable or Reclaimed Water Mains

When called for in the bid, wet connections will be paid at the unit price bid per each, complete in place, according to the size of the main that is in service and shall be full compensation for all Work

required to make the connection and place the pipe in service. (See subsection 510.3 'Construction Methods' part (24) (b) 'Wet Connections to Existing Water System').

(6) Fittings

Ductile iron fittings, furnished in accordance with these specifications, will be paid for at the unit price bid per ton, complete in place, according to the schedule of weights in Standard Products List WW-27C. Bolts, glands, and gaskets will not be paid for separately and shall be included in the contract unit price for fittings.

(7) Concrete Trench Cap and Encasement

Where the distance between the top of the concrete encasement and the top of the trench cap is less than 36 inches, the concrete cap and encasement shall be poured as one unit and paid for under this bid item at the Contract price bid per linear foot. When the distance above is greater than 36 inches or when the trench cap is placed separately, the trench cap shall be paid for as a separate item, per linear foot, complete in place.

(8) Cement-Stabilized Backfill

Cement-stabilized backfill will be paid for at the unit price bid per linear foot and shall be full payment to the Contractor for furnishing and installing the required material, mixed, placed and cured complete in place.

(9) Concrete Encasement

When called for in the Bid, Concrete Pipe Encasement will be paid under Item No. 505S, "Encasement and Encasement Pipe".

(10) Pressure Taps

Pressure taps will be paid for at the unit price bid, complete in place, according to the size tap made and the size main tapped and shall be full payment for furnishing all necessary materials, including tapping sleeve and valve, making the tap, testing and placing the connection in service.

(11) Excavation Safety Systems

When called for in Bid, Trench Safety Systems shall conform to Item No. 509S, "Excavation Safety Systems."

(12) Connecting a New Water, Wastewater, or Reclaimed Water Service to an existing, comparable type of private service will be paid for at the unit price bid, complete in place, according to the size of new service and size of existing private service, and shall be full payment for furnishing and installing all necessary materials, such as cleanouts, pipe, couplings, and fittings, and including excavation and backfill.

(13) Video Inspection

Video Inspection of Newly Installed Box Culverts and Storm Drain Pipe will be paid for at the unit price bid per linear foot and shall be full payment for all labor, equipment, and materials required for video inspection per this specification, including all submittals of CD/DVD as required.

(14) Jumper Hose

Jumper Hose will be paid at the unit bid price, complete and in place, including installation and removal of all materials necessary to provide a fully functional jumper hose. This item shall also include adequate protection for the jumper hose within vehicular traffic areas.

Source: Rule No. R161-17.05 , 5-31-2017.

Payment, when included as a Contract pay item, will be made under one of the following:

Pay Item No. 510-AR ___ Dia.:	Pipe, ___ Dia. ___ Type (all depths), including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-ARRJ ___ Dia.:	Factory Restrained Joint Pipe, ___ Dia., Class ___ Ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-BR ___ x ___ Dia.:	Connecting New ___ Service to Existing Private Service (___ Dia. New Service to ___ Dia. Private Service)	Per Each.
Pay Item No. 510-CR:	Pipe Excavation, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-DR:	Pipe Trench Backfill, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-ER:	Concrete Seal or Cradle, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-FR:	Concrete Trench Cap, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-GR:	Concrete Cap and Encasement, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-HR:	Cement Stabilized Backfill, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-IR: ___ x ___ Dia.:	Pressure Taps, ___ Dia. x ___ Dia.	Per Each.
Pay Item No. 510-JR: ___ x ___ Dia.:	Wet Connections, ___ Dia. x ___ Dia.	Per Each.
Pay Item No. 510-KR:	Ductile Iron Fittings	Per Ton.
Pay Item No. 510-ASD ___ Dia.:	Pipe, ___ Dia. (all depths), including excavation and backfill	Per Linear Foot.
Pay Item No. 510-CSD:	Pipe Excavation, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-DSD:	Pipe Trench Backfill, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-ESD:	Concrete Seal or Cradle, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-FSD:	Concrete Trench Cap, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-GSD:	Concrete Cap and Encasement, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-HSD:	Cement Stabilized Backfill, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-AW ___ Dia.:	Pipe, ___ Dia. ___ Type (all depths), including excavation and backfill	Per Linear Foot
Pay Item No. 510-AWRJ ___ Dia.:	Factory Restrained Joint Pipe, ___ Dia., Class Ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-BW ___ x ___ Dia.:	Connecting New ___ Service to Existing Private Service (___ Dia. New Service to ___ Dia. Private Service)	Per Each.
Pay Item No. 510-CW:	Pipe Excavation, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-DW:	Pipe Trench Backfill, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-EW:	Concrete Seal or Cradle, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-FW:	Concrete Trench Cap, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-GW:	Concrete Cap and Encasement, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-HW:	Cement Stabilized Backfill, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-IW: ___ x ___ Dia.:	Pressure Taps, ___ Dia. x ___ Dia.	Per Each.
Pay Item No. 510-JW: ___ x ___ Dia.:	Wet Connections, ___ Dia. x ___ Dia.	Per Each.
Pay Item No. 510-KW:	Ductile Iron Fittings	Per Ton.
Pay Item No. 510-AWW: ___ Dia.:	Pipe, ___ Dia. ___ Type (all depths), including Excavation and Backfill	Per Linear Foot.

Pay Item No. 510-AWWRJ ___ Dia.:	Factory Restrained Joint Pipe, ___ Dia., Class ductile Iron, (all depths) including Excavation and Backfill	Per Linear Foot.
Pay Item No. 510-BWW ___ x ___ Dia.:	Connecting New ___ Service to Existing Private Service (___ Dia. New Service to ___ Dia. Private Service)	Per Each.
Pay Item No. 510-CWW:	Pipe Excavation, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-DWW:	Pipe Trench Backfill, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-EWW:	Concrete Seal or Cradle, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-FWW:	Concrete Trench Cap, ___ Ft. Width	Per Linear Foot.
Pay Item No. 510-GWW:	Concrete Cap and Encasement, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-HWW:	Cement Stabilized Backfill, ___ Dia. Pipe	Per Linear Foot.
Pay Item No. 510-KWW:	Ductile Iron Fittings	Per Ton.
Pay Item No. 510-VIDEO	Video Inspection of Newly Installed Box Culverts and Storm Drain Pipe	Per Linear Foot.
Pay Item No. 510-JH	2-inch Jumper Hose	Per Linear Foot.

An "R" after the pay item indicates the use for reclaimed water.

An "SD" after the pay item indicates the use for storm drain.

A "W" after the pay item indicates the use for water.

A "WW" after the pay item indicates the use for wastewater.

Source: Rule No. R161-17.05 , 5-31-2017.

End

Applicable References:

Standard Specifications Manual: Item Nos. Ref: 102S, 210S, 402S, 403, 501S, 505S, 506, 507S, 509S, 593S, 601S, 604S

Standards Manual: Standard Detail Nos. 510S-1, (520 - series).

Design Criteria Manuals: Utilities Criteria Manual, Section 5.

ITEM NO. 511S WATER VALVES 9-26-12**511S.1 Description**

This item shall govern the valves furnished and installed as indicated on the Drawings. Unless otherwise indicated on the Drawings, all valves 4 inches (102 mm) and larger shall be AWWA-type valves of suitable design and fully equipped for service buried in the earth, without need for further modification and shall be wrapped with 8-mil (0.2 mm) polyethylene film with all edges and laps securely taped to provide a continuous wrap. For reclaimed water piping, the polyethylene film shall be purple. Where not indicated, the Contractor may use valves with any type end-joint allowed for fittings of the pipe class being used. Unless otherwise indicated on the Drawings, all valve stems shall be adjusted to situate the operating nut not more than 24 inches (0.6 meters) below the proposed ground or paving surface of the finished project. Laydown valves shall not be used unless called out on the Drawings. Standard details shall not be used as an indicator of available options.

This specification is applicable for projects or work involving either inch-pounds or SI units. Within the text, inch-pound units are given preference followed by SI units shown within parentheses.

511S.2 Materials

The Contractor shall submit descriptive information and evidence that the materials and equipment the Contractor proposes for incorporation in the Work is of the kind and quality that satisfies the specified functions and quality. The Austin Water Utility Standard Products Lists (SPL) are considered to form a part of these Specifications. Contractors may, when appropriate, elect to use products from the SPL; however, submittal to the Engineer/Architect (E/A) is still required. If the Contractor elects to use any materials from these lists, each product shall be completely and clearly identified by its corresponding SPL number when making the product submittal. This will expedite the review process in which the E/A, and, if necessary, the Austin Water Utility Standard Products Committee, decide whether the products meet the Contract requirements and the specific use foreseen by the E/A in the design of this engineered Project.

The SPL's should not be interpreted as being a pre-approved list of products necessarily meeting the requirements for a given construction Project. Items contained in the SPL cannot be substituted for items shown on the Drawings, or called for in the specifications, or specified in the Bidding Requirements, Contract Forms and Conditions of Contract, unless approved by the E/A in conjunction with the Water and Wastewater Utility Standard Products Committee. The Standard Product List current at the time of plan approval will govern.

A. Samples, Inspection and Testing Requirements

All tests and inspections called for by the applicable standards shall be performed by the manufacturer. Upon request, results of these tests shall be made available to the purchaser.

B. Other Requirements

Each submittal shall be accompanied by:

1. Complete data covering:
 - a. the operator, including type and size, model number, etc.,
 - b. the name and address of the manufacturer's nearest service facility,
 - c. the number of turns to fully open or close the valve.
2. detailed instructions for calibrating the limit stops for open and closed positions, and

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3. any other information, that may be necessary to operate and maintain the operator.
 4. Complete dimensional data and installation instructions for the valve assembly as it is to be installed, including the operator.
 5. Complete replacement parts lists and drawings, identifying every part for both the valve and operator.

511S.3 Valves

A. Iron-Body Gate Valves

Resilient-seated gate valves for potable or reclaimed service, including tapping valves, shall conform to AWWA C-509 and Standard Products List item WW-282.

Reduced-wall, resilient-seated gate valves for potable or reclaimed service, including tapping valves, shall conform to AWWA C-515 and Standard Products List item WW-700.

Metal-seated gate valves for potable or reclaimed service, including tapping valves, shall conform to AWWA C-500 and Standard Products List item WW-132.

1. Stem Seals: All valves shall have approved O-ring type stem seals. At least two O-rings shall be in contact with the valve stem where it penetrates the valve body.
2. Operation: All valves shall have non-rising stems with a 2-inch (50 mm) square operating nut, or with a spoke type handwheel when so ordered, turning clockwise to close.
3. Gearing: Gate valves in 24-inch (610 mm) and larger sizes shall be geared and, when necessary for proper bury depth and cover, shall be the horizontal bevel-geared type enclosed in a lubricated gear case.
4. Bypass: Unless otherwise indicated on the Drawings, 30-inch (762 mm) and larger metal-seated gate valves shall be equipped with a bypass of the non-rising stem type which meets the same AWWA standard required for the main valve.
5. Valve Ends: Valve ends shall be push-on, flanged or mechanical joint, as indicated or approved.

Tapping valves shall have inlet flanges conforming to MSS SP-60, with boltholes drilled per ANSI B16.1 Class 125. Seat rings and body casting shall be over-sized as required to accommodate full size cutters; the outlet end shall be constructed and drilled to allow the drilling machine adapter to be attached directly to the valve.

6. Gear Case: All geared valves shall have enclosed gear cases of the extended type, attached to the valve bonnet in a manner that makes it possible to replace the stem seal without disassembly and without disturbing the gears, bearing or gear lubricant. Gear cases shall be designed and fabricated with an opening to atmosphere so that leakage past the stem seal does not enter the gear case.
7. Valve Body: Double disc gate valves in 30-inch (762 mm) and larger sizes installed in the horizontal position shall have bronze rollers, tracks, scrapers, etc. For reclaimed water valves, the body shall be manufactured in purple, factory painted purple, or field painted purple.

B. Butterfly Valves

Unless otherwise indicated, all valves shall conform to the current "AWWA" Standard C-504, "Rubber-Seated Butterfly Valves," Class 150B, except as modified or supplemented herein.

1. Functional Requirements
 - a. Valves shall be the short body design and shall have flanged connections on both ends unless otherwise called for.

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- b. Valves shall be of such design that the valve discs will not vibrate or flutter when operated in a throttled position. Valve discs shall be secured to the shafts by means of keys or pins so arranged that the valve discs can be readily removed without damage thereto. All keys and pins used in securing valve discs to shafts shall be stainless steel or monel. Valve discs shall be stainless steel or ductile iron, ASTM A 536, Grade 65-45-12 (448-310-12); seating edge shall be stainless steel or other corrosion resistant material.
 - c. Valve shafts shall be constructed of wrought stainless steel or monel. The ends of the shaft shall be permanently marked to indicate the position of the disc on the shaft.
 - d. All buried valves shall have approved manufacturer's O-ring type or split V type "Chevron" shaft seals. When O-ring seals are used, there shall be at least two O-rings in contact with the valve shaft where it penetrates the valve body.

On 24-inch (635 mm) and larger valves, the seat shall be completely replaceable and/or adjustable with common hand tools without disassembling the valve from the pipeline.

Rubber seats located on the valve disc shall be mechanically secured with stainless steel retainer rings and fasteners.

- e. Unless otherwise indicated, valves shall be provided with manual operators with vertical stems and 2 inches (50 mm) square operating nut turning clockwise to close and equipped with a valve disc position indicator. All keys or pins shall be stainless steel or monel. Buried valves shall have the valve stems extended or adjusted to locate the top of the operating nut no more than 24 inches (0.6 meter) below finish grade.
 - f. Unless otherwise indicated, motorized butterfly valves shall be equipped with 230/460 volt, 3-phase reversing motor operators, extended as required to locate the center line of the operator shaft approximately 4 feet to 4 feet, 6 inches (1.2 to 1.4 meters) above finish grade. Operators shall be equipped with cast iron or malleable iron manual override hand wheel with a valve position indicator, local push button controls, lighted status/position indicator, torque and travel limit switches and all switches, relays and controls (except external power and signal wiring) necessary for both local and remote operation.
2. Performance Requirements
- a. Unless otherwise indicated, valve operators shall be sized to seat, unseat, open and close the valve with 150 psi (1 megapascal) shutoff pressure differential across the disk and allow a flow velocity of 16 feet (4.9 meters) per second past the disc in either direction.
 - b. Motorized valve motors shall be capable of producing at least 140 percent of the torque required to operate the valves under conditions of maximum non-shock shutoff pressure without exceeding a permissible temperature rise of 1310F over 1040F ambient (55 degrees Celsius over 40 degrees Celsius ambient); they shall have a duty rating of not less than 15 minutes and shall be capable of operating the valve through 4½ cycles against full unbalanced pressure without exceeding the permissible temperature rise. Motors shall be suitable for operating the valve under maximum differential pressure when voltage to motor terminals is 80 percent of nominal voltage. Motor bearings shall be permanently lubricated and sealed.

C. Ball Valves

Ball valves shall be brass, bronze, stainless steel or PVC as indicated on the Drawings or Details or as approved by the Engineer or designated representative.

D. Air-Vacuum Release Valves

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1. Valves shall be combination air-release, air-vacuum units having small and large orifice units contained and operating within a single body or assembled unit.

The small orifice system shall automatically release small volumes of air while the pipe is operating under normal conditions. The large air-vacuum orifice system shall automatically exhaust large volumes of air while the pipe is being filled and shall permit immediate re-entry of air while being drained.

Valves shall be rated for at least 150 psi (1 megapascal) {maximum}normal service pressure.

2. Material Requirements

Valve exterior bodies and covers shall be cast iron or reinforced nylon.

Internal bushings, hinge pins, float guide and retaining screws, pins, etc., shall be stainless steel, bronze, nylon, or Buna-N rubber.

Orifice seats shall be Buna-N rubber.

Floats shall be stainless steel, nylon, or Buna-N rubber, rated at 1,000 psi (6.9 megapascals).

Unless otherwise indicated, these valves shall be as included in the Standard Products List (SPL WW-367 for water, WW-462 for wastewater force mains).

E. Fire Hydrants

All fire hydrants shall be Dry Barrel, Traffic Model (break-away), Post Type having Compression Type Main Valves with 5 ¼" (133 mm) opening, closing with line pressure. Approved models are listed on SPL WW-3 of the Austin Water Utility Standard Products List.

1. Applicable Specifications

AWWA C-502 current: "AWWA Standard for Dry-Barrel Fire Hydrants."

NFPA 1963: "National (American) Standard Fire Hose Coupling Screw Thread" and City of Austin 4 inch (102 mm) Fire Hose Connection Standard (Available upon request from the Austin Water Utility's Standards Committee Chairperson at 972-0204).

ANSI A-21.11 current: "American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings."

2. Functional Requirements

Design Working Pressure shall be 200 psi (1.38 megapascals) and a test pressure of 400 psi (2.76 megapascals).

Inlet shall be side connection hub end for mechanical joint (ANSI A-21.11-current). Shoe shall be rigidly designed to prevent breakage.

Lower Barrel shall be rigid to assure above ground break at traffic feature. Bury length of hydrant shall be four (4) feet (1.2 meters) minimum, five (5) feet (1.5 meters) maximum (hydrant lead pipe may be elbowed up from main using restrained joints; flanged joints in lead pipes are not allowed). Flange type connections between hydrant shoe, barrel sections and bonnet shall have minimum of 6 corrosion resistant bolts.

Hydrant Main Valve shall be 5 ¼ inch (133 mm) I.D. Valve stem design shall meet requirements of AWWA C502, with Operating Nut turning clockwise to close. Operating Nut shall be pentagonal, 1½ inch (38 mm) point to flat at base, and 1 7/16 inches (36.5 mm) at top and 1 inch (25 mm) minimum height. Seat ring shall be bronze (bronze to bronze threading), and shall be removable with lightweight

stem wrench. Valve mechanisms shall be flushed with each operation of valve; there shall be a minimum of two (2) drain ports.

Traffic Feature shall have replaceable breakaway ferrous metal stem coupling held to stem by readily removable type 302 or 304 stainless steel fastenings. Breakaway flange or frangible lugs shall be designed to assure aboveground break. Breakaway or frangible bolts will not be acceptable.

Outlet Nozzles shall be located approximately 18 inches (450 mm) above ground. Each hydrant shall have two (2) 2½ inch (63.5 mm) nozzles 180 degrees apart with National (American) Standard Fire Hose Coupling Screw Thread NFPA 1963 and one (1) 4 inch (102 mm) pumper nozzle with City of Austin standard thread-six (6) threads per inch (25 mm) "Higbee" cut, 4.8590 inch (123.4 mm) O.D., 4.6425 inch (117.9 mm) root diameter. Nozzles shall be threaded or cam-locked, O-ring sealed, and shall have type 302 or 304 stainless steel locking devices. Nozzle caps (without chains) and cap gaskets shall be furnished on the hydrant. The cap nut shall have the same configuration as the operating nut.

Hydrants shall be Dry-Top Construction, factory lubricated oil or grease with the lubricant plug readily accessible. The system shall be described for City approval.

A blue Type II-B-B reflectorized pavement marker, conforming to Standard Specification Item No. 863S, shall be placed 2 to 3 feet (0.6 to 0.9 meters) offset from the centerline of paved streets, on the side of and in line with, all newly installed fire hydrants.

Hydrant shall have double O-ring seals in a bronze stem sheath housing to assure separation of lubricant from water and shall have a weather cap or seal, or both, as approved by the Owner, to provide complete weather protection.

3. Material Requirements

All below ground bolts shall be corrosion resistant. The hydrant valve shall be Neoprene, 90 durometer minimum. The seat ring, drain ring, operating nut and nozzles shall be bronze, AWWA C-502 current, containing not over 16 percent zinc. Break-away stem coupling shall be of ferrous material; its retaining pins, bolts, nuts, etc. of type 302 or 304 stainless steel.

Coatings shall be durable and applied to clean surfaces. Exterior surfaces above ground shall receive a coating of the type and color specified in the applicable version of City of Austin SPL WW-3. The coating shall be applied according to coating manufacturer's specifications. Other exposed ferrous metal shall receive asphalt-based varnish, or approved equal, applied according to the coating manufacturer's specifications.

F. Pressure/Flow Control Valves

All control valves to regulate pressure, flow, etc., in City lines shall be models listed in the Austin Water Utility Standard Products List (SPL).

G. Drain Valves

Drain valve materials and installation shall conform to City of Austin Standard Detail No. 511S-9.

H. Valve Stem Extensions:

Valve stem extensions shall consist of a single piece of the required length with a socket on one end and a nut on the other.

511S.4 Construction Methods

A. Setting Valves, Drains and Air Releases

Unless otherwise indicated, main line valves, drain valves and piping, air and vacuum release assemblies and other miscellaneous accessories shall be set and jointed in the manner described for cleaning, laying, and jointing pipe.

Unless otherwise indicated, valves shall be set at the locations shown on the Drawings and such that their location does not conflict with other appurtenances such as curb ramps. Valves shall be installed so that the tops of operating stems will be at the proper elevation required for the piping at the location indicated above. Valve boxes and valve stem casings shall be firmly supported and maintained, centered and aligned plumb over the valve or operating stem, with the top of the box or casing installed flush with the finished ground or pavement in existing streets, and installed with the top of the box or casing approximately 6 inches (150 mm) below the standard street subgrade in streets which are excavated for paving construction or where such excavation is scheduled or elsewhere as directed by the Engineer or designated representative.

Drainage branches or air blowoffs shall not be connected to any sanitary sewer or submerged in any stream or be installed in any other manner that will permit back siphonage into the distribution system (see City of Austin "Standard Detail Drawings- Series 500/500S"). Every drain line and every air release line shall have a full sized independent gate valve flanged directly to the main. Flap-valves, shear gates, etc., will not be accepted.

B. Setting Fire Hydrants

Fire hydrants shall be located in a manner to provide accessibility and in such a manner that the possibility of damage from vehicles or conflict with pedestrian travel will be minimized. Unless otherwise directed, the setting of any hydrant shall conform to the following:

Hydrants between curb and sidewalk on public streets, shall be installed as shown on Standard 511S-17, with outermost point of large nozzle cap 6 inches to 18 inches (150 mm to 450 mm) behind back of curb. Where walk abuts curb, and in other public areas or in commercial areas, dimension from gutter face of curb to outermost part of any nozzle cap shall be not less than 3 feet (0.9 meters), nor more than 6 feet (1.8 meters), except that no part of a hydrant or its nozzle caps shall be within 6 inches (150 mm) of any sidewalk or pedestrian ramp. Any fire hydrant placed near a street corner shall be no less than 20 feet (6 meters) from the curb line point of tangency. Fire hydrants shall not be installed within nine feet (2.75 meters) vertically or horizontally of any sanitary sewer line regardless of construction.

All hydrants shall stand plumb; those near curbs shall have the 4-inch (102 mm) nozzle facing the curb and perpendicular to it. The hydrant bury mark shall be located at ground or other finish grade; nozzles of all new hydrants shall be approximately 18 inches (450 mm) above grade. Lower barrel length shall not exceed 5 feet (1.5 meters). Barrel extensions are not permitted unless approved by the Engineer or designated representative. Each hydrant shall be connected to the main by 6-inch (152 mm) ductile iron pipe; a 6-inch (152 mm) gate valve shall be installed in the line for individual shutoff of each new hydrant.

Below each hydrant, a drainage pit 2 feet (0.6 meter) in diameter and 2 feet (0.6 meter) deep shall be excavated and filled with compacted coarse gravel or broken stone mixed with coarse sand under and around the bowl of the hydrant, except where thrust blocking is located (City of Austin Specification Item 510 and Standard Detail 510-6 and to a level 6 inches (150 mm) above the hydrant drain opening.

The hydrant drainage pit shall not be connected to a sanitary sewer. The drain gravel shall be covered with filter fabric to prevent blockage of voids in the gravel by migration of backfill material. The bowl of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete thrust blocking (taking care not to obstruct the hydrant drain holes), or the hydrant shall be tied to the pipe with approved metal harness rods and clamps. The fire line shall be provided with joint restraint from the main line to the fire hydrant. Hydrants shall be thoroughly cleaned of dirt or foreign matter before setting.

Fire hydrants on mains under construction shall be securely wrapped with a poly wrap bag or envelope taped into place. When the mains are accepted and placed in service the bag shall be removed.

C. Pressure Taps: Refer to Section 510.3 (24) of Standard Specification Item Number 510, "Pipe."

D. Plugging Dead Ends

Standard plugs shall be inserted into the bells of all dead ends of pipes, tees or crosses and spigot ends shall be capped. All end plugs or caps shall be secured to the pipe conforming to Section 510.3 (22) of Standard Specification Item Number 510, "Pipe."

E. Protective Covering

Unless otherwise indicated, all flanges, nuts, bolts, threaded outlets and all other steel component shall be coal tar coated and shall be wrapped with standard minimum 8-mil (0.2 mm) low density polyethylene film or a minimum 4-mil (0.1 mm) cross laminated high-density polyethylene meeting ANSI/AWWA Specification C-105-current, with all edges and laps taped securely to provide a continuous and watertight wrap. Repair all punctures of the polyethylene, including those caused in the placement of bedding aggregates, with duct tape to restore the continuous protective wrap before backfilling. For reclaimed water piping, the polyethylene shall be purple.

F. Valve Box, Casing and Cover

Stems of all buried valves shall be protected by valve box assemblies. Valve box castings shall conform to ASTM A 48, Class 30B. Testing shall be verified by the manufacturer at the time of shipment. Each casting shall have cast upon it a distinct mark identifying the manufacturer and the country of origin. Valve boxes and covers for potable water shall be round. Valve boxes and covers for reclaimed water piping shall be square and shall have "Reclaimed Water" indicated on the lid.

G. Drain Valve Installations

Refer to City of Austin Standards 511S-9A.

H. Air Release Assemblies

Refer to City of Austin Standards 511S-1A, 511S-1B, 511S-2A, 511S-2B, 511S-3A and 511S-3B.

I. Pressure/Flow Control Valves

Assemblies shall be installed as indicated.

J. Connections to Existing System

Refer to Item No. 510, "Pipe" for connections to the existing system.

K. Shutoffs

Refer to Item No. 510, "Pipe" for shutoffs.

511S.5 Measurement

All types of valves will be measured per each. Fire hydrants and drain valve assemblies will be measured per each. Fire Hydrant barrel extensions will be measured per vertical foot (meter: 1 meter equals 3.28 feet). Pressure/Flow control valve assemblies and both manual and automatic air release assemblies will be measured per each. Reflectorized pavement markers for identifying the location of newly installed fire hydrants shall be measured per each, as per Standard Specification Item No. 863S.7.

Bury depths exceeding 5.5 feet (1.68 meters) are defined as Additional Bury Depths. Additional bury depths will only be measured if indicated on the Drawings and identified in the Standard Contract Bid Form 00300U; otherwise, the unit bid price for each completed unit includes all depths.

511S.6 Payment

Payment shall include full compensation, in accordance with the pay item established in the bid, for excavation, furnishing, hauling and placing valves, drain valve assemblies, fire hydrants and barrel extensions including anchorage and all incidental materials and work; preparing, shaping, dewatering, bedding, placing and compacting backfill materials and for all other incidentals necessary to complete the installation, as indicated in the Drawings, complete in place.

Payment for iron fittings and for wet connections is covered in Section 510.6 of Standard Specification Item 510, "Pipe."

Payment for excavation safety systems is covered in Section 509S.10 of Standard Specification Item 509S, Excavation Safety Systems.

- A. Valves: Valves will be paid for at the unit bid price for the size and type valve installed, including valve stem casing and cover, excavation and backfill, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation.
- B. Fire Hydrants: Fire Hydrants installation shall be paid for at the unit bid price, which includes all necessary labor and materials to set, adjust to grade and anchor the hydrant body, barrel extensions, concrete block, gravel drain and other appurtenances necessary for proper operation; but shall not include pipe and valve between the main line and fire hydrant base.
- C. Pressure or Flow Control Valve Assemblies: Pressure control and flow control valve assemblies will be paid for at the unit bid price, including box or vault, setting, adjusting to grade, anchoring in place, adjusting the control device to the required conditions, providing other appurtenances necessary for proper operation, and placing in operation.
- D. Drain Valve Assemblies: Drain valve installation shall be paid for at the unit bid price, which includes all necessary labor and materials to set, adjust to grade and anchor the bends, vertical piping, blind flange, joint restraint devices, concrete blocking, concrete pad the drain valve, setting, adjusting to grade, anchoring in place, and other appurtenances necessary for proper operation; but shall not include pipe and valve between the main line and drain valve buried bend.
- E. Manual Air Release Assemblies: Manual air release installations will be paid for at the unit bid price and shall include valves, fittings, pipe, tapping the main, box and cover, and other appurtenances necessary for proper operation.
- F. Automatic Combination Air/Vacuum Release Valve Assembly: Automatic air-vacuum release assemblies will be paid for at the unit bid price and will include the main line tap or outlet, all pipe, valves, fittings, box or vault and cover, and other appurtenances necessary for proper operation.
- G. Additional Bury Depth: Additional bury depth will be paid for at the unit bid price, which will include all work necessary to install units with bury depths exceeding 5.5 feet (1.68 meters).
- H. Fire Hydrant Barrel Extensions: Hydrant barrel extensions will be paid for at the unit bid price which will include necessary hardware and rod extensions.
- I. Reflectorized Pavement Markers: Pavement markers will be paid for at the unit bid price, which will include necessary surface preparation and adhesive, as per Standard Specification Item No. 863S.8.

Payment, when included as a contract pay item, will be made under one of the following:

Pay Item No. 511S-A:	Valves, _____ Type, ____ Diameter	Per Each.
Pay Item No. 511S-B:	Fire Hydrants (See Standard No. 511S-17)	Per Each.
Pay Item No. 511S-C:	Pressure or Flow Control Valve Assemblies	Per Each.

Pay Item No. 511S-D:	Drain Valve Assemblies (See Standard No. 511S-9A)	Per Each.
Pay Item No. 511S-E:	Manual Air Release Assemblies, ___ Diameter	Per Each.
Pay Item No. 511S-F:	Automatic Combination Air/Vacuum Release Valve Assembly, ___ Diameter.	Per Each.
Pay Item No. 511S-G:	Additional Bury Depth	Per Vertical Foot.
Pay Item No. 511S-H:	Fire Hydrant Barrel Extensions	Per Vertical foot.

END

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Specification 511S, "Water Valves"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 510	Pipe
Section 510.3 (22)	Pipe Anchorage, Support and Protection
Section 510.3(24)	Water System Connections
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
511S-1A	25 mm (1") - 76 mm (2") Vented Air Release Valve Installation (Type I)
511S-1B	25 mm (1") - 76 mm (2") Non-Vented Air Release Valve Installation (Type I)
511S-2A	Type II - 76 mm (3") or Larger Vented Air/Vacuum Valve Installation
511S-2B	Type II - 76 mm (3") or Larger Non-Vented Air/Vacuum Valve Installation
511S-3A	Type III - 76mm (3") or Larger Vented Air/Vacuum Valve Installation
511S-3B	Type III-76mm (3") or Larger Non-Vented Air/Vacuum Valve Installation
511S-9A	Drain Valve Assembly
511S-17	Standard Fire Hydrant Installation
<u>Austin Water Utility Standard Products</u>	
<u>Designation</u>	<u>Description</u>
WW-132	Standard Products List for Metal-Seated Gate Valves, AWWA C-500
WW-282	Standard Products List for Resilient-Seated Gate Valves, AWWA C-509
WW-367	Standard Products List for Air Release Valves for Water
WW-462	Standard Products List for Air Release/Vacuum Relief Valves for Wastewater
WW-700	Standard Products List for Resilient-Seated Gate Valves, AWWA C
<u>ANSI/AWWA Standards</u>	
<u>Designation</u>	<u>Description</u>
A-21.11	American National Standard for Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings
C-105	American National Standard for Polyethylene Encasement for Ductile-Iron Pipe
C-500	Metal-Seated Gate Valves for Water Supply Service
C-502	Dry-Barrel Fire Hydrants
C-504	Rubber-Seated Butterfly Valves
C509	Resilient Seated Gate Valves for Water and Sewerage Systems
C-515	Reduced-Wall, Resilient-Seated Gate Valves For Water Supply Service-515

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<u>ASTM Standards</u>	
<u>Designation</u>	<u>Description</u>
ASTM A48/A48M	Specification for Gray Iron Castings
ASTM A 536	Specification for Ductile Iron Castings
<u>National Fire Protection Association (NFPA)</u>	
1963 National (American) Standard Fire Hose Coupling Screw Thread	

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 511S, "Water Valves"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 501S	Jacking or Boring Pipe
Item No. 503S	Frames, Grates, Rings and Covers
Item No. 505S	Concrete Encasement and Encasement Pipe
Item No. 506	Manholes
Item No. 507S	Bulkheads
Item No. 508S	Miscellaneous Structures and Appurtenances
Item No. 509S	Trench Safety Systems

ITEM NO. 559S PORTLAND CEMENT CONCRETE BOX CULVERTS 10-3-13**559S.1 Description**

This item governs the materials used and the constructing, furnishing and placing of concrete box culverts (boxes) on a prepared grade at the location shown on the Drawings and in accordance with Standard Detail 559S-1, "Fabrication Tolerances for Precast Box Culverts". Unless indicated otherwise on the Drawings, the Contractor shall have the option of furnishing cast-in-place, precast (formed) or precast (machine made) concrete box culverts.

When cast-in-place box culverts are used, they shall conform to the details indicated on the Drawings and Standard Detail 559S-1, "Fabrication Tolerances for Precast Box Culverts" along with the requirements for Standard Specification Item No. 403S, "Concrete for Structures" and Standard Specification Item No. 410, "Concrete Structures".

The manufacturing of precast box culverts shall conform to the requirements of the current version of ASTM C1577. When precast box culverts are used under traffic, the design loads shall consist of the impact load, dead load and live load [AASHTO LRFD Bridge Construction Design Specifications - greater of: Truck Axle load (32Kf {identical to HS-20load axial load of 32Kf}) or Tandem Axle load (2 at 25Kf each)].

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

559S.2 Submittals

The submittal requirements of this specification item include for both cast-in-place and precast boxes:

- A. The foundation plan and drilling/excavation details;
- B. Class C and S Portland cement concrete mix design for cast-in-place boxes;
- C. Anchor bolt plan and details;
- D. Reinforcing Steel details and placement drawings;
- E. Casting plan and details (if required);
- F. Certification of compliance with HL93 Liveload design standards;
- G. Bedding Material;
- H. Joint design;
- I. List of joint sizes showing the minimum size of sealant material to be used with each size joint, along with complete instructions on recommended installation procedures;
- J. Test results of the hydrostatic performance testing of the joints, if requested by the City;
- K. Box Culvert manufacturer's recommended final joint opening (gap) dimension on the inside of the installed box;
- L. Certification from the QCast Program, which provides a third party certification auditing firm to certify that the manufacturing plant is producing boxes based on the requirements of the National Precast Concrete Association;
- M. Inspection procedures to be used by the manufacturer for quality control and assurance for materials; and
- N. 5000 psi (34.475 mPa) Concrete mix design for machine made boxes.

559S.3 Quality Control

Manufacturers of concrete boxes shall have a quality management system certified by the QCast Program following the requirements of the American Concrete Pipe Association (ACPA) Plant Certification Manual. Manufacturers of concrete boxes, inlets and storm water manholes shall have a quality control program consisting of one or more of the following: 1) a quality management system certified by the QCast Program following the requirements of the ACPA Plant Certification Manual, 2) a quality management system certified by the National Precast Concrete Association. 3) a quality control program approved by the OWNER prior to submittal of bids for the PROJECT, or 4) an independent, third party quality control testing and inspection firm for testing and inspecting box culverts produced for the PROJECT and approved by the OWNER prior to submittal of bids for the PROJECT.

All such quality control programs shall be paid for by the manufacturer. It is the intent of this requirement that the manufacturer will document all appropriate tests and inspections with sampling and inspection criteria, frequency of testing and inspection, date of testing and inspection and date on which every piece was manufactured. Required testing and inspection, including that by an independent, third party, shall be performed full-time during production of box culverts for the PROJECT. When requested by the OWNER, the manufacturer will provide copies of test data and results and inspection reports with the shipment of box culverts for the PROJECT. Test data and results and inspection reports shall be traceable to specific box culverts lots or pieces. Owner approval of the manufacturer's quality control program will expire after three years, at which time the manufacturer must present a current quality control program for approval.

The quality of materials and, the process of manufacturing and furnishing box culverts shall be subject to inspection and approval by the E/A at the box culvert manufacturing plant and at the project site prior to and during installation. Plant inspections shall be conducted at the discretion of the City Representative. Only manufacturers having a quality control program of the type described above will be considered as approved providers of concrete box culverts and storm water manholes.

559S.4 Materials

A. Concrete

Class C Concrete shall be used for cast-in-place and precast (formed) box culverts conforming to the requirements of Standard Specification Item No. 403S, "Concrete Structures" and Standard Specification Item No. 410S, "Concrete for Structures", except that Class S Portland cement Concrete will be required for the top slab of direct traffic boxes.

Portland cement concrete for precast (machine made) boxes shall conform to the current version of ASTM C 1577 and shall have a minimum 28-day compressive strength of 5,000 psi (34.475 mPa).

B. Reinforcement

Reinforcing steel for cast-in place and precast (formed) box culverts shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

Reinforcing steel for machine made boxes shall in accordance with ASTM C1577

C. Jointing Material

Unless otherwise shown on the drawings, when installing box culverts, the Contractor shall have the option of making joints with preformed flexible joint sealants or with rubber gaskets. Preformed flexible joint sealants for box culvert joints shall comply with ASTM C990, and rubber gaskets for box culvert joints shall comply with ASTM C1677. Mortar shall not be used to seal pre-fabricated joints. Box culvert joint shall be designed to prevent the flow of solids through the joint.

D. Membrane Curing

Materials for membrane curing for cast-in-place and precast (formed) box culverts shall conform to Standard Specification Item No. 409S, "Membrane Curing". Materials for membrane curing for machine made boxes shall be in accordance with ASTM C1577.

E. Admixtures

Admixtures for all box culverts shall conform to Standard Specification Item No. 405S, "Concrete Admixtures". Air entraining admixtures shall be added to the mixture to produce concrete with not less than 4, nor more than 7 percent, air content by volume.

F. Granular Backfill

Materials for Granular Backfill shall conform to Standard Specification Item No. 210S, "Flexible Base".

G. Foundation Rock

Bedding material shall be 1-inch (25 mm) to 3-inch (75mm) diameter clean gravel or crushed gravel or crushed rock in conformance with Standard Specification Item No. 510 "Pipe."

H. Geotextile Filter Fabric for Bedding Material

Geotextile filter fabric for bedding material shall be Webtec, Terra Tex NO 4 (AOS US Standard Sieve 70) geotextile fabric or approved equal.

559S.5 Fabrication

The fabrication of machine-made precast boxes shall comply with ASTM C1577.

Forms for precast (machine made) boxes shall be made of steel. Forms for precast (formed) boxes may be either wood or steel. Forms shall be mortar-tight and of sufficient strength to prevent bulging or misalignment of adjacent boxes. They shall be constructed to permit their removal without damage to the concrete. Offsets at form joints shall not exceed $\frac{1}{8}$ inch (3.2-mm). Forms shall be clean and free of extraneous matter when Portland cement concrete is placed.

Positive means of supporting steel cages in place throughout forming and Portland cement concrete placement will be required and subject to the approval of the Engineer or designated representative. Welding of reinforcing steel will be permitted only where shown on the Drawings. Welding shall be done by a qualified welder.

Precast (machine made) boxes shall be cast by a process, which will provide for uniform placement of the Portland cement concrete in the forms and compaction by mechanical devices, that will assure dense concrete. Portland cement concrete shall be mixed in a central batch plant or other approved batching facility from which the quality and uniformity of the Portland cement concrete can be assured. Transit-mixed concrete will not be acceptable for use in precast (machine made) boxes.

Curing of precast boxes made in a commercial plant shall be by any one or by a combination of the following methods, which are compatible with the joint materials selected or as directed by the Engineer or designated representative.

A. Steam Curing

Boxes will be placed in a curing chamber, free from outside drafts and cured in a moist atmosphere maintained by the injection of steam for such time and temperature as necessary for proper curing. The curing chamber shall be constructed to allow full circulation of steam around the entire box. Steam outlets shall be positioned so that live steam is not applied directly to the Portland cement concrete.

B. Water Curing

Boxes may be water cured by covering with water saturated cotton mats, polyethylene sheeting or polyethylene burlap blankets, by a system of perforated pipe or mechanical sprinklers, by porous hose or by

other methods that will keep the boxes moist during the curing period. Water for curing shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

C. Membrane Curing

Type 1 membrane curing compound may be used for interim curing or for complete curing. All surfaces shall be kept moist prior to the application of the curing compound and shall be damp when the compound is applied.

When used for interim curing, the curing compound shall be applied to the outside surface of the box upon removal of forms. It shall also be applied to the inside surface or a suitable covering may be placed over the box opening to protect the inside of the box against rapid drying.

When used for complete curing, curing compound shall be applied to the inside surface of the box when interim curing is applied or when handling strength has been attained, but not later than 24 hours after casting.

Curing shall not be delayed longer than 1 hour after the Portland cement concrete has been placed in the forms or more than ½ hour after removal of forms, unless interim curing is applied.

Precast boxes made in a commercial plant shall be continuously cured for a period of 3 days after reaching handling strength or until the design strength has been attained. Curing may be interrupted for no more than 30 minutes for form removal and no more than 4 hours for removal to a storage area and resumption of curing. All precast boxes shall be protected from freezing during the curing period.

A curing day is a calendar day when the air temperature, taken in the shade away from artificial heat, is above 50°F (10°C) for at least 19 hours or for colder days if satisfactory provisions are made to maintain the temperature at all surfaces of the concrete above 50°F (10°C) for the entire 24 hours.

Test cylinders shall be cured at the same time and in the same manner as the boxes.

Not more than 4 lifting holes may be provided in each box to facilitate handling. They may be cast-in, cut into the fresh Portland cement concrete after form removal or drilled and shall not be more than 2 inches (50-mm) in diameter or 2 inches (50-mm) square. Cutting or displacement of reinforcement will not be permitted. Spalled areas around the holes shall be repaired. Concrete boxes shall be given an ordinary finish conforming to Standard Specification Item No. 410S, "Concrete Structures".

Precast boxes of either type, made in a plant, shall bear the following marking:

- The name or trademark of the manufacturer;
- The date of manufacture;
- The box size and height of fill.

When fitting holes are not provided, one end of each box section shall be clearly marked on the inside and outside walls to indicate the top and/or bottom as it will be installed.

Marking shall be indented into the box or may be painted thereon with waterproof paint.

D. Grout and Bentonite Slurry Injection Holes

Box culvert sections installed by trenchless tunneling and jacking method shall have drilled or fabricated grout injection holes and bentonite slurry injection holes as required by Standard Technical Specification Item No. 501S Jacking or Boring Pipe and its special provision. Injection holes shall be 1½ inch (38 mm) minimum diameter with plugs cast into the box culvert at the time of manufacture.

559S.6 Testing

Precast box culverts made in a commercial plant shall be tested and accepted in accordance with ASTM C1577.

Testing of cast-in-place and precast (formed) box culverts shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

559S.7 Fabricating Tolerances

Tolerances for precast boxes of either type shall conform to the following:

- A. The inside vertical and horizontal dimensions shall not vary from plan requirements more than + ½ inch (12.5-mm).
- B. The horizontal or vertical plane at each end shall not vary from being perpendicular to the top and bottom by more than ½ inch (12.5-mm) when measured diagonally between opposite interior corners of the end section.
- C. The sides of a section at each end shall not vary from being perpendicular to the top and bottom by more than ½ inch (12.5-mm) when measured diagonally between opposite interior corners of the end section.
- D. The thickness of walls and slabs shall not be less than that required by the Drawings, except that an occasional deficiency not greater than ¼ inch (6.3-mm), will be acceptable. If proper jointing is not affected, thicknesses in excess of Drawing requirements are acceptable.
- E. The straightness of the tongue and groove at the mating surface shall not vary by more than ¼ inch (6.3-mm).

Deviations from the above tolerances will be acceptable if the box sections can be fitted at the plant or job site and it is determined that an acceptable joint can be made. For this condition, an acceptable joint is:

When 2 box sections are fitted together on a flat surface in proper alignment and in the position they will be installed, the longitudinal opening at any point shall not exceed 1 inch (50-mm). Box sections accepted in this manner shall be match-marked for installation.

559S.8 Defects and Repair

Fine cracks or checks on the surface of the member which do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Cracks, which extend into the plane of the reinforcing steel, but are acceptable otherwise, shall be repaired in an approved manner.

Small damaged or honeycombed areas, which are purely surface in nature, may be repaired. Excessive damage, honeycomb or cracking will be subject to structural review. Repairs shall be sound, properly finished and cured in conformance with the pertinent specifications.

When fine cracks or hairchecks on the surface indicate poor curing practices, further production of precast boxes shall be discontinued until corrections are made and proper curing provided.

559S.9 Storage and Shipment

Precast boxes shall be stored on level blocking in a manner acceptable to the Engineer or designated representative. No load shall be placed upon them until design strength is reached and curing completed. Shipment of boxes may be made when the design strength and curing requirements have been met.

559S.10 Construction Methods

Excavation and backfill shall conform to Standard Specification Item No. 401S, "Structural Excavation and Backfill" and Standard Specification Item No. 510, "Pipe", except where tunneling or jacking methods are required or indicated on the Drawings.

Precast concrete boxes shall be bedded on a foundation of firm stable material accurately shaped to conform to their base. When indicated on the Drawings, special bedding materials shall be provided.

The envelope shall extend the full trench width from a depth of 6" (150 mm) and shall rise to at least 12" (300 mm) above the box. Geotextile filter fabric shall be placed within the bedding envelope approximately 8" (200 mm) above the top of the box and covered with a minimum of 4" (100 mm) of bedding material to protect fabric during placement of compaction and backfill. Damaged fabric should be removed and replaced or overlapped at least 12" (300 mm).

Joints sealed with preformed flexible joint sealants shall comply with ASTM C990. Joints sealed with rubber gaskets shall comply with ASTM C1677. Install joint sealants in accordance with the box culvert and joint sealant manufacturers' recommendations. Place the joint sealer so that no dirt or other deleterious materials come in contact with the joint sealing material. Pull or push home the box culvert with enough force to properly seal the joint. Remove any joint material pushed out into the interior of the box culvert to be flush and smooth with the inside surface of the box culvert. Protrusion of joint material greater than $\frac{1}{8}$ " (3.13 mm) into the interior of the box culvert shall be grounds for rejection of the box as installed. Observe joint sealant manufacturer's recommendations for installation temperature of the joint sealant. Apply joint sealant to box culvert joint immediately before placing box culvert section in trench, and then connect box culvert section to previously laid box culvert section.

Contractor shall provide video recording of installed box culverts, in accordance with the video recording work requirements of Standard Specification Item No. 510.

If video inspections reveals joints where soil infiltration is evident, or where joints or conduits are otherwise defective, then the contractor shall remove and replace all affected conduit or repair joints using joint repair techniques recommended by the manufacturer to achieve a completed system that meets all Contract requirements.

When precast boxes are used to form multiple barrel structures, they shall be placed in conformance with the details indicated on the Drawings. Materials to be used between barrels shall be as indicated on the Drawings.

Connections of precast boxes to cast-in-place boxes or to any required headwalls, wingwalls, riprap or other structures shall conform to the details indicated on the Drawings.

Lifting holes shall be filled with mortar or concrete and cured to the satisfaction of the Engineer or designated representative.

559S.11 Measurement

A. Cast in Place Box Culverts

The quantities of Portland cement concrete of the various classifications, which will constitute the completed and accepted "Box Culverts" in place will be measured by the cubic yard (cubic meter: 1 cubic meter equals 1.308 cubic yards), based on the dimensions indicated on the Drawings.

B. Precast

Concrete box culverts of each size and type shall be measured by the lineal foot (lineal meter: 1 lineal meter equals 3.28 lineal feet). The measurement will be made between the ends of the box along the central axis.

For concrete boxes used in multiple barrel structures, the measured length will be the sum of the lengths of all barrels measured as described above.

559S.12 Payment

"Concrete Box Culverts" shall be full compensation for constructing, furnishing and transporting boxes; excavation; disposal of surplus or unusable excavated material; providing, hauling, placing, preparing and shaping bedding material and leveling courses; concrete, reinforcing steel; jointing of boxes; connections to existing systems or structures; connections to new systems or structures; preparing, shaping, pumping for dewatering up to 360 gpm; particle migration measures including geotextile filter fabric; hauling, moving, placing and compacting backfill materials; installation and maintenance of temporary pavement repairs; temporary removal and replacement of pavement, curb, drainage structures, driveways, sidewalks, and any other improvements damaged or removed during construction;; and all other items of material, labor, equipment, tools and incidentals necessary to complete this work in accordance with the Drawings and specifications.

Video recording shall be paid for under Standard Specification 510:

Payment will be made under one of the following:

Item No. 559S:	Precast Concrete Box Culverts, ___ Ft. x ___ Ft.	Per Lineal Foot.
Item No. 559S-A:	Cast in Place Concrete Box Culverts	Per Cubic Yard.

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Standard Specification Item No. 559S, "Concrete Box Culverts"</u>	
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
Detail No. 559S-1	Fabrication Tolerances for Precast Box Culverts
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 210S	Flexible Base
Item No. 403S	Concrete for Structures
Item No. 405S	Concrete Admixtures
Item No. 406S	Reinforcing Steel
Item No. 409S	Membrane Curing
Item No. 410S	Concrete Structures
Item No. 509S	Trench Safety Systems
Item No. 510	Pipe
<u>American Society for Testing and Materials,</u>	
<u>ASTM Designation</u>	<u>Description</u>
C 1577	Standard Specification for Precast reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD
<u>Texas Department of Transportation, Manual of Testing Procedures</u>	
<u>Test Method</u>	<u>Description</u>

Tex 704-1	Making, Curing, and Testing Compression Test Specimens in Precast Concrete
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RELATED CROSS REFERENCE MATERIALS	
Standard Specification Item No. 559S, "Concrete Box Culverts"	
Texas Department of Transportation: Standard Specifications for Construction, Maintenance Of Highways, Streets and Bridges	
<u>Designation</u>	<u>Description</u>
Item No. 420	Concrete Structures
Item No. 421	Portland Cement Concrete
Item No. 440	Reinforcing Steel

ITEM NO. 591S RIPRAP FOR SLOPE PROTECTION 1-4-16

591S.1 Description

This item shall govern the excavation of all materials encountered for placing riprap, disposal of excess material and backfilling around the completed riprap to the grade indicated on the Drawings. The work shall include all pumping and bailing, furnishing and placing riprap of rock or concrete in accordance with the details and to the dimensions indicated on the Drawings.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses. The work conducted under this item pertains to riprap for protection of slopes, cuts, fills, drainage facilities and other features susceptible to erosion.

Source: Rule No. R161-15.14, 1-4-2016 .

591S.2 Submittals

The submittal requirements for this specification item shall include:

- A. The type, size, gradation, physical properties and source of rock riprap material; test data for specific gravity, absorption, soundness; and field verification of the rock riprap gradation including a size distribution plot and a list of the measured D15, D50, D85, and D100 (refer to Item No. 591S.3.A).
- B. The type, size, and source of broken concrete riprap material.
- C. Aggregate types, gradations and physical characteristics for the Portland cement concrete mix.
- D. Proposed proportioning of materials for the mortar mix.
- E. Type, details and installation requirements for reinforcement, joint material, tie backs and anchors.
- F. Description of filter fabric including characteristics, test data and manufacturer's recommendations for installation.
- G. The type, size, gradation and source of granular filter material.

Where vegetated soil-riprap is used, and proposed materials differ from the materials already approved for use elsewhere on the project, the submittal requirements also include:

- H. Identification of the seed species, source, mixture, pure live seed (PLS) as listed on the analysis tags, certification tags from all seed bags, and seed calculation worksheet per Item No. 604S, Table 9.
- I. Soil retention blanket material type, evidence that the material is listed on the TxDOT Approved Products List, one (1) full set of manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.
- J. Identification of fill soil class, source, and characteristics of proposed borrow material as described in Item No. 130S Borrow.
- K. Identification of topsoil source and characteristics including textural (clay/silt/sand) percentage.

Source: Rule No. R161-15.14, 1-4-2016 .

591S.3 Materials

A. Rock

The rock shall be suitable in all respects for the purpose intended. Rock sources shall be selected well in advance of the time the rock will be required and shall be pre-approved by the Engineer. Rock used for riprap shall be hard, durable, and angular in shape and consist of clean field rock or rough unhewn quarry rock as nearly uniform in section as practicable. Neither the width nor the thickness of a single rock shall be less than one-third of its length. The rocks shall be dense, resistant to weathering and water action, and free of overburden, spoils, shale, and organic material. Shale, chalk, and limestone with shale or chalk seams shall not be acceptable. Rounded rock (river rock) shall not be acceptable.

The rock durability shall be evaluated by laboratory tests for specific gravity, absorption, and soundness. The minimum specific gravity shall be 2.4 (150 pounds per cubic foot) and the maximum absorption 4.2% using ASTM D 6473 or Tex-403-A. Soundness shall be tested in accordance with ASTM D 5240 or Tex-411-A and weight loss shall not exceed 18% after 5 cycles of magnesium sulfate solution, nor 14% after 5 cycles of sodium sulfate solution.

The rock riprap material shall be provided as a gradation of larger and smaller rock sizes associated with a rock class or median diameter (D50) as specified in the drawings. Rock diameter for angular material represents the length of the intermediate axis of an individual rock. The material gradation shall conform to table below for the class sizes corresponding to the D50. The D15, D50, D85, and D100 are the rock sizes for which 15%, 50%, 85%, and 100% of the total sample are of equal size or smaller, respectively.

Rock Riprap Gradation Table								
Rock Riprap Class by Median Particle Diameter (D50)		D15 (in)		D50 (in)		D85 (in)		D100 (in)
Class	Diameter (in)	Min	Max	Min	Max	Min	Max	Max
I	6	3.7	5.2	5.7	6.9	7.8	9.2	12.0
II	9	5.5	7.8	8.5	10.5	11.5	14.0	18.0
III	12	7.3	10.5	11.5	14.0	15.5	18.5	24.0
IV	15	9.2	13.0	14.5	17.5	19.5	23.0	30.0
V	18	11.0	15.5	17.0	20.5	23.5	27.5	36.0
VI	21	13.0	18.5	20.0	24.0	27.5	32.5	42.0
VII	24	14.5	21.0	23.0	27.5	31.0	37.0	48.0
VIII	30	18.5	26.0	28.5	34.5	39.0	46.0	60.0
IX	36	22.0	31.5	34.0	41.5	47.0	55.5	72.0
X	42	25.5	36.5	40.0	48.5	54.5	64.5	84.0

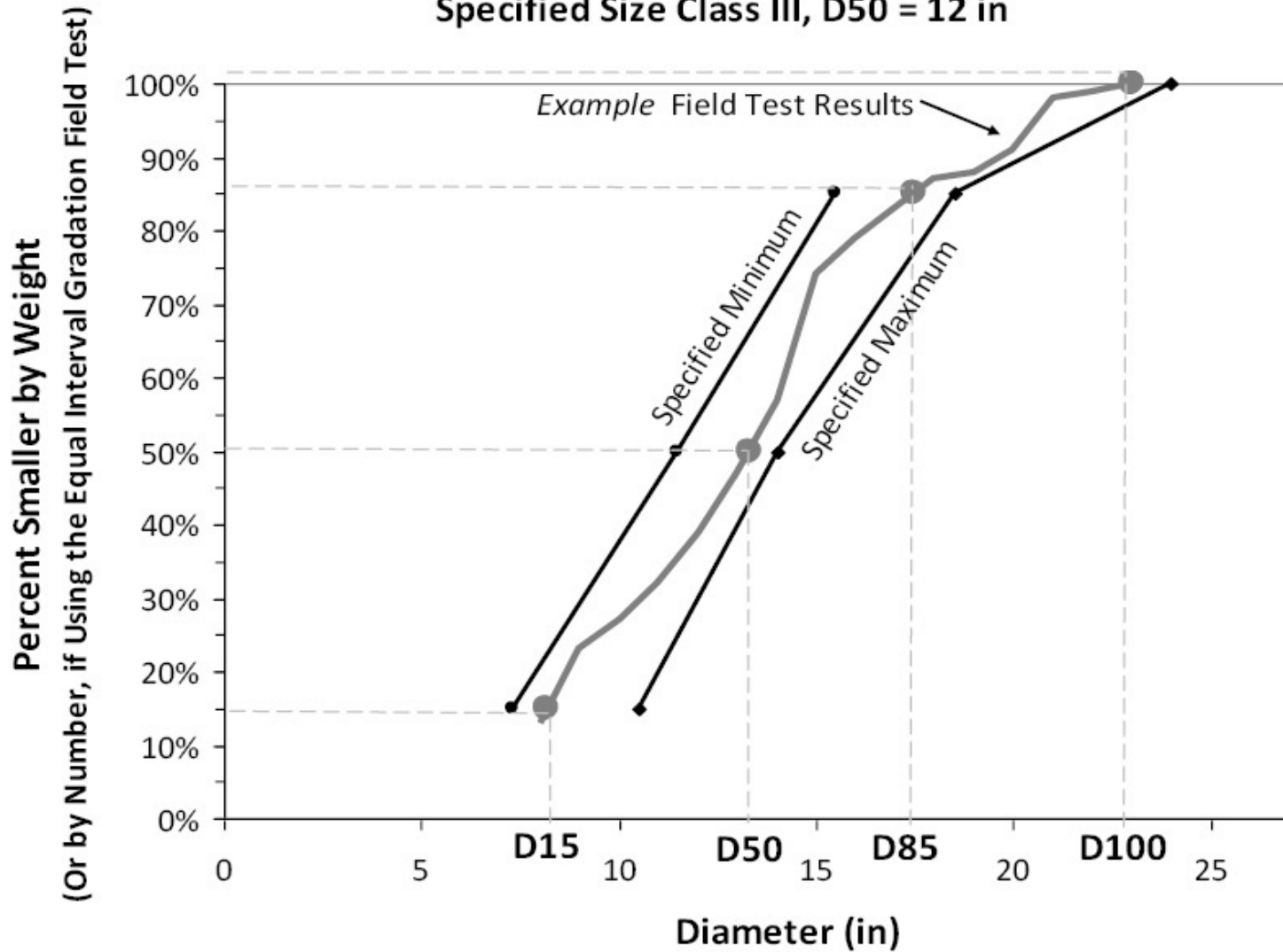
1. Reference: NCHRP Report 568.
2. Conversion to weight-based gradation: $W = 0.0275D^3Sg$ where W is rock size in lbs, D is diameter in inches and Sg is the specific gravity of the rock.

Conformance of rock riprap to the gradation requirements shall be accomplished by field tests for rock sizes that cannot be analyzed via sieve or mechanical sorting machines. In order to perform a field test, the contractor shall provide a sample of the proposed rock riprap material meeting the gradation for the specified size class. Gradation field tests shall follow the equal interval test procedure in NCHRP Report 568, Section 3.2.3, ASTM D 5519, or the modified equal interval method. The general steps of the modified equal interval method are:

-
1. Spread a representative, well-mixed sample of riprap to form a flat, rectangular pile. The thickness of the pile should be approximately equal to the D100. The length and width of the footprint should be determined based on the rock size and the minimum sample size that is requested by the Engineer.
 2. With a tape measure, create a linear transect across the sample pile. Mark each rock that falls directly under the tape measure at an equal interval. The interval should be two feet or greater, depending on the D50, such that no rock is marked more than once.
 3. Lay additional transects parallel to the first transect, at a spacing equal to the interval between marked rocks. Repeat Step B for each transect such that the marked rocks form an equally spaced grid across the pile.
 4. Measure the diameter of each marked rock across the intermediate (middle or B) axis. The number of rocks measured shall be equal or greater than the minimum sample size.
 5. Analyze the data by sorting and plotting a curve of percent smaller by number vs diameter. Identify the diameters.

Gradation tests shall result in: (1) a size distribution plot comparing the measured sample data with the specified diameter ranges for the rock size class (example below), and (2) the calculated D100, D85, D50, and D15 of the rock sample. The sample gradation is acceptable if the calculated diameters fall within the specified ranges of the applicable gradation. The acceptability of rock that falls outside the specified gradation ranges shall be at the discretion of the Engineer.

Example Plot: Riprap Gradation Field Test
Specified Size Class III, D50 = 12 in



Approved rock riprap samples shall be stored onsite as a reference for ongoing visual inspection of additional materials supplied. Supplementary tests may be required for supply materials where visual inspection determines their may be a deviation from the required gradation. Labor, equipment and site location needed to assist in checking gradation shall be provided by the contractor at no additional cost to the owner.

B. Broken Concrete

The rock used for mortar riprap may consist of broken concrete removed under the contract or obtained from other approved sources. Broken concrete shall be as nearly uniform in section as practicable and of the sizes indicated in Section 591S.4.A, "Dry Riprap".

C. Concrete

Cast in place concrete shall be Class A Concrete and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

D. Grout and Mortar

Grout and mortar shall consist of 1 part Portland Cement and 3 parts sand, thoroughly mixed with water. Mortar shall have a consistency such that it can be easily handled and spread by trowel. Grout shall have a consistency such that it will flow into and completely fill all joints.

E. Reinforcement

Reinforcement shall conform to Standard Specification Item No. 406S, "Reinforcing Steel".

F. Joints

Premolded expansion joint material shall conform to Standard Specification Item No. 408, "Concrete Joint Material".

G. Tie Backs and Anchors

Galvanized tie backs and anchors shall be as indicated on the Drawings.

H. Filter Fabric

Filter Fabric shall conform to Standard Specification Item No. 620S, "Filter Fabric".

I. Granular Filter

Aggregate used for granular filters shall conform to Standard Specification Item No. 403S "Concrete for Structures".

J. Soils

For vegetated soil-rock riprap, soil shall be integrated with the rock riprap at 30% soil to 70% rock by volume with minimal voids. Unless specified otherwise in the Drawings, soil that is placed below six inches (6") below the riprap top surface shall be Class A Select Borrow material, as described in Item No. 130S Borrow, and referred to herein as "fill soil." Soil that is placed within the top six inches (6") of the riprap top surface shall be topsoil material as described in Item No. 601S Salvaging and Placing Topsoil, Section 3.

K. Seed

For vegetated soil-rock riprap, the type of seed mix and application rates shall be as specified on the Drawings and within the referenced Standard Specification. If no seed mix is specified, apply according to Item No. 604S Seeding for Erosion Control, Section 6.

L. Soil retention blanket.

For vegetated soil-rock riprap, soil retention blanket shall be TxDOT-approved Class 1 Type C or D, shall be made of 100% biodegradable fibers, unless specified otherwise in the Drawings, Blanket shall comply with the requirements of Item No. 605S Soil Retention Blanket, Section 3.

Source: Rule No. R161-15.14, 1-4-2016 .

591S.4 Construction Methods

Prior to commencement of this work, all required erosion control and tree protection measures (Standard Specification Item 610S, "Preservation of Trees and Other Vegetation") shall be in place and utilities located and protected as set forth in the "General Conditions". Construction equipment shall not be operated within the drip line of trees unless indicated on the Drawings. Construction materials shall not be placed under the canopies of trees. No excavation or embankment shall be placed within the drip line of trees until tree wells (Standard Detail Number 610S-6, "Tree Protection, Tree Wells") are constructed. Spalls and small stones used to fill open joints and voids in rock riprap shall be rocked and wedged to provide a tight fit.

Unsuitable excavated materials or excavation in excess of that needed for construction shall be known as "Waste" and shall become the property of the Contractor and it shall become his sole responsibility to dispose of this material in an environmentally sound manner off the limits of the right of way at a permitted disposal site.

All blasting shall conform to 01550, "Public Safety and Convenience." The Contractor shall comply with all laws, ordinances, applicable safety code requirements, International Fire Code Chapter 27 "Hazardous Materials General Provisions" and Chapter 33 "Explosives and Fireworks" and any other regulations relative to handling, storage and use of explosives. In all cases, a Blasting Permit must be obtained in advance from the appropriate City agency.

Areas to be protected by rock riprap shall be free of brush, trees, stumps and other objectionable materials and be graded to a smooth compacted surface. All soft or spongy material shall be removed and replaced with appropriate material to the depths shown on the plans or as directed by the engineer. Fill Areas, unless otherwise specified will be compacted in accordance with 132S - Embankment. Unacceptable subgrade conditions shall be reworked according to the Engineer's recommendations. Excavation areas shall be maintained until the riprap is placed.

A. Dry Rock Riprap

The mass of rock riprap shall be placed as to be in conformance with the required gradation mixtures, to the lines, grades and layers thickness that is shown on the drawings.

When the riprap will be placed on an erodible soil, as determined by the Engineer or designated representative, a layer of geotextile filter fabric or a granular filter layer shall be placed, prior to placement of the riprap material. In some cases multiple layers of granular filter material of varying gradations may be required. The median rock riprap size (D50), rock riprap layer thickness, filter type, when applicable the number of granular filter layers, granular filter aggregate gradations (grade/size classification), granular layer thicknesses shall be specified on the plans. The minimum granular filter layer thickness shall be 4 inches (102 mm). Geotextile filter fabric shall conform to Standard Specification No. 620 and be installed with sufficient anchoring and overlap between seams according to the manufacturer's recommendations to ensure full filter barrier protection of the subgrade after riprap installation. When specified on the plans a four (4) inch minimum thickness granular cushion layer of gravel or sand may be placed over the filter fabric to prevent damage the fabric during placement of rock riprap.

Rock riprap shall be machine placed and distributed such that there will be no large accumulations of either larger or smaller sizes. Placing rock riprap by dumping into chutes or similar methods shall not be permitted. The rocks shall be placed in a single layer with close joints. The rock riprap layer thickness shall be no less than the specified maximum stone size (D100) or 1.5 times the D50, whichever produces the greater thickness. In areas exposed to flowing water the rock riprap layer thickness should be no less than 2.0 times the D50. The upright axis of the rocks shall make an angle of approximately 90 degrees with the embankment slope. The courses shall be placed from the bottom of the embankment upward, with the larger rocks being placed on the lower courses. Open joints shall be filled with spalls. Rocks shall be arranged to present a uniform finished top surface such that the variation between tops of adjacent rocks shall not exceed 3 inches (75 mm). Rocks that project more than the allowable amount in the finished work shall be replaced, embedded deeper or chipped.

B. Mortared Rock Riprap

Rock for this purpose, as far as practicable, shall be selected as to size and shape in order to secure fairly large, flat-surfaced rock which may be laid with a true and even surface and a minimum of voids. Fifty percent of the mass rock shall be broad flat rocks, weighing between 100 and 150 pounds (45 and 69 kilograms) each, placed with the flat surface uppermost and parallel to the slope. The largest rock shall be placed near the base of the slope. The spaces between the larger rocks shall be filled with rocks of suitable size, leaving the surface smooth, reasonably tight and conforming to the contour required on the Drawings. In general, the rocks shall be placed with a degree of care that will insure

plane surfaces with variation from the true plane of no more than 3 inches in 4 feet (no more than 60 mm per meter). Warped and curved surfaces shall have the same general degree of accuracy as indicated for plane surfaces.

Before placing mortar, the rocks shall be wetted thoroughly and as each of the larger rocks is placed, it shall be surrounded by fresh mortar and adjacent rocks shall be shoved into contact. After the larger rocks are in place, all of the spaces or opening(s) between them shall be filled with mortar and the smaller rocks then placed by shoving them into position, forcing excess mortar to the surface and insuring that each rock is carefully and firmly embedded laterally. After the work described above has been completed, all excess mortar forced up shall be spread uniformly to completely fill all surface voids. All surface joints then shall be pointed up roughly, either with flush joints or with shallow, smooth raked joints.

C. Vegetated Soil-Rock Riprap

Adjacent stockpiles of rock riprap, fill soil, and topsoil shall be created and there shall be no premixing of fill soil, topsoil and rock prior to placement. Sufficient soil volume shall be provided to result in a final, complete-in-place ratio of 30% soil to 70% rock riprap by volume.

Place underlying filter material and first layer of rock riprap in accordance with 591S.4.A to a thickness equivalent to the D50 rock size or half the design rock layer thickness, whichever is greater. Place a layer of soil over and within the rock voids such that the top of the soil layer is approximately 75% of the rock layer thickness. Work the soil into the rock layer voids by wetting, prodding with a rock bar, and/or vibratory compaction until the soil height is approximately 50% of the rock height. If the soil height becomes less than 50% of the rock height then repeat the previous steps.

Place the second layer of rock riprap per 591S.4.A up to the final design grade. Place soil over and within the rock riprap, working it into the voids as in the previous step and repeating application as needed until the top of the soil layer approximately matches the top surface of the rock riprap. Excess soil shall not be placed in the voids to the extent that the rock riprap is displaced. The resulting soil-riprap surface shall be smooth, with no lumps or depressions greater than two inches ($\pm 2''$) from the final design grade.

Once the soil-rock matrix is placed, the surface of the soil-rock riprap shall be seeded per the Drawings and covered with biodegradable erosion control fabric.

D. Concrete Riprap

Concrete for riprap shall be placed as indicated on the Drawings or as directed by the Engineer or designated representative. Unless otherwise indicated on the Drawings, concrete riprap shall be reinforced using wire or bar reinforcement.

Concrete shall be Class A or as indicated otherwise on the Drawings and shall conform to Standard Specification Item No. 403S, "Concrete for Structures".

When welded wire reinforcement is indicated, it shall be a minimum of 6 × 6 W1.4 × W1.4 (150 × 150 MW9 × MW9) with a minimum lap of 6 inches (150 mm) at all splices. At the edge of the riprap, the wire fabric shall not be less than 1 inch (25 mm) nor more than 3 inches (75 mm) from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete.

When bar reinforcement is used, the sectional area of steel in each direction shall not be less than the sectional area of the wire fabric described above. The spacing of bar reinforcement shall not exceed 18 inches (450 mm) in each direction and the distance from the edge of concrete to the first parallel bar shall not exceed 6 inches (150 mm).

Reinforcement shall be supported properly throughout the placement to maintain its position approximately equidistant from the top and bottom surface of the slab.

Unless otherwise noted, expansion joints of the size and type indicated on the Drawings shall be provided at intervals not to exceed 40 feet (12.2 meters) and shall extend the full width and depth of the concrete. Marked joints shall be made 3/8 inch (9.5 mm) deep at 10 foot (3 meter) intervals. All joints shall be perpendicular and at right angles to the forms unless otherwise indicated on the Drawings.

Slopes and bottom of the trench for toe walls shall be compacted and the entire area sprinkled before the concrete is placed.

After the concrete has been placed, consolidated and shaped to conform to the dimensions indicated on the Drawings and has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface.

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410S, "Concrete Structures".

E. Pneumatically Placed Concrete Riprap, Type I and Type II

Pneumatically placed concrete for riprap shall be placed as indicated on the Drawings or as established by the Engineer or designated representative. Pneumatically placed concrete shall conform to Standard Specification Item No. 404S, "Pneumatically Placed Concrete". Reinforcement shall conform to the details indicated on the Drawings and Standard Specification Item No. 406S, "Reinforcing Steel". Reinforcement shall be supported properly throughout placement of concrete. All subgrade surfaces shall be moist when concrete is placed.

The surface shall be given a wood float finish or a gun finish as indicated on the Drawings.

The strength and design of Pneumatically Placed Concrete Riprap shall be either Type I or if indicated, Type II conforming to Standard Specification Item No. 404S, "Pneumatically Placed Concrete".

Immediately following the finishing operation, the riprap shall be cured conforming to Standard Specification Item No. 410S, "Concrete Structures".

591S.5 Measurement

Measurement of acceptable riprap will be made on the basis of the (a) area in square yards (square meters: 1 square meter equals 1.196 square yards) indicated on the Drawings, complete in place or (b) the volume of concrete placed in cubic yards (cubic meters: 1 cubic meters equals 1.308 cubic yards), complete in place as indicated on the Drawings for the thickness specified.

Concrete toe walls will not be measured separately but shall be included in the unit price bid for riprap of the type with which it is placed.

591S.6 Payment

The riprap quantities, measured as provided above, will be paid for at the unit bid prices per square foot or per cubic yard as indicated for riprap of the various classifications. The Unit Bid Price shall include full compensation for furnishing, hauling and placing all materials, including toe walls, geotextile filter fabric, granular filter material, fill soil and top soil, seed, erosion control fabric, granular cushion, reinforcement and premolded expansion joint material and for all labor, tools, equipment and incidentals necessary to complete the work.

Payment for excavation of toe wall trenches and for all necessary excavation below natural ground or the bottom of excavated drainage channels will be included in the unit bid price for riprap. Excavation, grading and fill materials required to shape drainage channels shall not be included in the unit bid price for riprap.

Payment for excavation required for shaping of slopes for riprap shall be included in the unit bid price for riprap, except for the situation when the header banks upon which the riprap is to be placed are built by prior contract. In this specific case the excavation for shaping of slopes, will be paid for conforming to Standard Specification Item No. 401, "Structural Excavation and Backfill".

Payment will be made under one of the following:

Pay Item No. 591S-A:	Dry Rock Riprap	Per Square Yard.
Pay Item No. 591S-B:	Dry Rock Riprap	Per Cubic Yard.
Pay Item No. 591S-D:	Mortared Rock Riprap	Per Square Yard.
Pay Item No. 591S-F:	Concrete Riprap, ___ In.	Per Square Yard.
Pay Item No. 591S-G:	Concrete Riprap	Per Cubic Yard.
Pay Item No. 591S-I:	Vegetated Soil-Rock Riprap	Per Square Yard.
Pay Item No. 591S-J:	Vegetated Soil-Rock Riprap	Per Cubic Yard.
Pay Item No. 591S-P:	Pneumatically Placed Concrete Riprap, ___ In.	Per Square Yard.

Source: Rule No. R161-15.14, 1-4-2016 .

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 591S, "Riprap for Slope Protection"</u>	
<u>International Fire Code</u>	
<u>Designation</u>	<u>Description</u>
Chapter 27	Hazardous Materials
Chapter 33	Explosives and Fireworks
<u>City of Austin Standard Contract Documents</u>	
<u>Designation</u>	<u>Description</u>
01550	Public Safety and Convenience
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 130S	Borrow
Item No. 403S	Concrete for Structures
Item No. 404S	Pneumatically Placed Concrete
Item No. 406	Reinforcing Steel
Item No. 408	Concrete Joint Material
Item No. 410	Concrete Structures
Item No. 601S	Salvaging and Placing Topsoil
Item No. 604S	Seeding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric

<u>American Society for Testing and Materials, ASTM</u>	
<u>Designation</u>	<u>Description</u>
ASTM D 5240	Standard Test Method for Evaluation of Durability of Rock for Erosion Control Using Sodium Sulfate or Magnesium Sulfate
ASTM D 5519	Standard Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials
ASTM D 6473	Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-403-A	Test Procedure for Saturated Surface-Dry Specific Gravity and Absorption of Aggregates
Tex-411-A	Soundness of Aggregate Using Sodium Sulfate or Magnesium Sulfate
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 432	Riprap

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 591S, "Riprap for Slope Protection"</u>	
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 623S	Dry Stack Rock Wall

Engineering Design Manuals

Federal Highway Administration, 1989, Design of Riprap Revetment, Hydraulic Engineering Circular HEC-11, FHWA-1P-89-016.

National Cooperative Highway Research Program, 2006, Riprap Design Criteria, Recommended Specifications, and Design Criteria, NCHRP Report 568.

United States Bureau of Reclamation, 1983, Hydraulic Design of Stilling Basins and Energy Dissipators, Engineering Monograph No. 25.

U.S Department of Agriculture, 1983, Soil Conservation Service, Riprap for Slope Protection Against Wave Action, Technical Release No. 69, February.

US Army Corps of Engineers, 1994. Hydraulic Design of Flood Control Channels, US Army Corps of Engineers Engineer Manual EM 1110-2-1601.

Federal Highway Administration, 1998. "Geosynthetic Design and Construction Guidelines," FHWA-HI-95-038.

ITEM NO. 601S SALVAGING AND PLACING TOPSOIL 11-14-16

601S.1 Description

This item shall govern the removal, storage and placement of approved on-site naturally occurring topsoil and topsoil mix (see 601S.3.A) to the depths and area shown on the Drawings or as directed by the Engineer or Landscape Architect.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

Source: Rule No. R161-16.21, 11-14-16 .

601S.2 Submittals

A. Submittals required before construction:

1. Soil test results and soil classification necessary for approval of material as suitable topsoil. Soil test results should include, at minimum, texture; percentage organic matter (OM); salinity (soil salt) level; pH; and amounts of phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), nitrate-nitrogen ($\text{NO}_3\text{-N}$), and sulfate-sulfur ($\text{SO}_4\text{-S}$).
2. For topsoil mixes containing compost, the soil test for shall also include moisture content, C:N ratio and Solvita compost maturity index.
3. A sample (1-gallon) of proposed topsoil or topsoil mix shall be submitted to the Owner or their representative 30 calendar days before installation and be approved before installation. Sample should be labeled including type of material, specification number; name, address, and telephone number of manufacturer or supplier; and address of the location of the source or material stockpile.

B. Submittals/Inspection required during construction:

1. Delivery tickets indicating type/product name, source and quantities of imported topsoil mix or compost (for mixing with salvaged soil).
2. Deliveries of soil to a job site shall be inspected by the project Engineer or Landscape Architect or Owner's construction inspector before placement to verify product compliance with specification.

Source: Rule No. R161-16.21, 11-14-16 .

601S.3 Materials

A. Topsoil Mix

1. Topsoil mix shall be composed of 4 parts of soil mixed with 1 part compost, by volume. The soil shall be locally available native soil that meets the following specifications:
 - a) Shall be free of trash, weeds, deleterious materials, rocks and debris.
 - b) 100% shall pass through a $\frac{3}{8}$ -inch (9.5 mm) screen.

- c) Soil to be a black or dark brown loamy material that meets the requirements of the table below in accordance with the USDA textural triangle. Soil known locally as "red death" is not an allowable soil. Textural composition shall meet the following criteria:

Textural Class	Minimum	Maximum
Clay	5%	50%
Silt	10%	50%
Sand	15%	67%

- d) Organic matter percentage shall be at least 5.0% after the addition of compost.
- e) Salinity shall be below 6.00 mmhos/cm.
- f) An owner/project designer(s) may propose use of onsite salvaged topsoil which does not meet the soil texture class required above by providing a soil analysis and a written statement from a qualified professional in soils, landscape architecture, or agronomy indicating the onsite topsoil will provide an equivalent growth media and specifying what, if any, soil amendments are required.
2. The compost shall be locally available and shall meet the following specifications:
- a) Shall be well decomposed, stable to very stable, weed-free plant-based material source derived from yard trimmings or City approved alternate source. The Carbon/Nitrogen (C/N) ratio shall be less than 25:1 and trace metals test results should "pass".
- b) Shall be blended and ground leaf, wood and other plant-based material, composted for a minimum of nine (9) months and at temperatures sufficient to break down all woody fibers, seeds and leaf structures, free of toxic material at levels that are harmful to plants or humans. Source material shall be yard waste trimmings blended with other plants or other materials designed to produce compost high in fungal material. Non-vegetal source materials may be acceptable upon approval by the Owner. The compost will possess no objectionable odors and shall not resemble the raw material from which it was derived.
- c) Compost shall be commercially prepared compost and meet US Compost Council STA/TMECC criteria or as modified in this section for "Compost as a Landscape Backfill Mix Component".
http://compostingcouncil.org/admin/wp-content/plugins/wp-pdfupload/pdf/191/LandscapeArch_Specs.pdf
- d) Compost shall comply with the following parameters:

PARAMETERS ¹	REPORTED AS (UNITS OF MEASURE)	GENERAL RANGE
pH	pH units	6.0 - 8.5
Salinity (electric conductivity)	dS/m (mmhos/cm)	Maximum 10
Moisture Content	%, net weight basis	30 - 60%
Organic Matter Content	%, dry weight basis	30 - 65%
Particle Size	% passing a selected mesh size, dry weight basis	98% pass through ¾ inch screen
Stability Carbon Dioxide Evolution Rate	mg CO ₂ -C per g OM per day	<8
Solvita Compost Maturity Test	Solvita units	>6
Physical Contaminants (inerts)	%, dry weight basis	<1%

Chemical Contaminants ²	mg/kg (ppm)	Meet or exceed US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels
Biological Contaminants Select pathogens Fecal coliform bacteria or Salmonella ³	MPN per gram per dry weight MPN per 4 grams per dry weight	Meet or exceed US EPA Class A standard, 40 CFR § 503.32(a) levels

¹ Recommended test methodologies are provided in Test Methods for the Examination of Composting and Compost (TMECC, The US Composting Council).

² US EPA Class A standard, 40 CFR § 503.13, Tables 1 and 3 levels = Arsenic 41 ppm, Cadmium 39 ppm, Copper 1,500 ppm, Lead 300 ppm, Mercury 17 ppm, Molybdenum 75 ppm, Nickel 420 ppm, Selenium 100 ppm, Zinc 2,800 ppm.

³ US EPA Class A standard, 40 CFR § 503.32(a) levels = Salmonella <3 MPN/4grams of total solids or Fecal Coliform <1,000 MPN/gram of total solids.

- e) Compost and other soil amendments shall be worked into the existing on-site topsoil with a disc or tiller to create a well-blended material.
2. All disturbed areas to be revegetated are required to provide a minimum of six (6) inches of topsoil. The topsoil shall be able to support the growth of planting (Standard Specification Item No. 608S), Seeding for Erosion Control (Standard Specification Item No. 604S), sodding (Standard Specification Item No. 602S) and Native Seeding and Planting for Restoration (Standard Specification Item No. 609S).
- B. **Water.** Water shall be furnished by the Contractor and shall be clean and free from seed source, pesticide, fertilizer, industrial wastes and other objectionable matter.

Source: Rule No. R161-16.21, 11-14-16 .

601S.4 Sources

The salvaged topsoil may be obtained from the right-of-way at sites of proposed excavation or embankment when shown on the Drawings or identified by the Engineer or Landscape Architect. The approximate quantity of acceptable topsoil to be salvaged from the project will be shown on the Drawings. The topsoil or topsoil mix may also be obtained from approved sources, which are located outside the right-of-way and have been secured by the Contractor.

Source: Rule No. R161-16.21, 11-14-16 .

601S.5 Construction Methods

Tree protection fencing will be maintained at all times to protect all trees in the limits of construction. Where removal of trees is indicated on the Drawings, they shall be marked as directed by the Engineer, Landscape Architect, or certified arborist.

Construction equipment shall not be operated nor construction materials stockpiled within the critical root zone of trees. Tree protection fencing shall remain in place per tree protection plan. Topsoil materials shall not be placed within the critical root zones of trees until tree wells are constructed that conform to Item No. 610S, "Preservation of Trees and Other Vegetation " and Standard Details 591S-1 and 610S-6. The source and stockpile areas shall be kept drained, insofar as practicable, during the period of topsoil removal.

The existing topsoil shall be removed from the area indicated on the Drawings, stockpiled in designated area on the site plan, windrow along the right-of-way or other designated area outside the 100-year floodplain (as defined in the Drainage Criteria Manual and Land Development Code) or spread over an area that is ready for topsoil application in accordance with the Drawings or as directed by the Engineer or Landscape Architect.

Trash, wood, brush, stumps, rocks over 1½ inches (37.5 mm) in size and other objectionable material encountered shall be removed and disposed of as directed by the Engineer or Landscape Architect prior to beginning of work required by this item. Grass and other herbaceous plant materials may remain. Large clumps shall be broken up.

Where the proposed planting area is compacted more than 85% proctor or 225 p.s.i., the existing soil should be tilled to a minimum depth of six inches before installation of the salvaged topsoil or topsoil mix. In the critical root zone of trees reference 661S.

The topsoil should not be placed if the ground is muddy, saturated, or frozen.

The topsoil should not be placed if the ground is extremely dry. Wet soil enough to prevent dust from leaving the site.

After the grading has been completed to the required alignment, grades and cross-sections and prior to the spreading of the salvaged topsoil, any clay or tight soil surfaces shall be scarified by plowing furrows approximately 4 inches (100 mm) deep along horizontal slope lines at 2 foot (600 mm) vertical intervals. The spreading of the salvaged topsoil or topsoil mix shall be undertaken as soon as the grading has been completed. The topsoil shall be spread so as to form a cover of uniform thickness indicated. After the topsoil has been placed and shaped, it shall be sprinkled with water and rolled to provide a suitable seed bed.

Source: Rule No. R161-16.21, 11-14-16 .

601S.6 Measurement and Payment

Salvaging, removal and/or placing topsoil materials will not be measured for payment, but shall be included in the unit price bid for the item of construction in which these activities are used.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 601S, "Salvaging and Placing Topsoil"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 608S	Planting
Item No. 609S	Native Seeding and Planting For Restoration
Item No. 610S	Preservation of Trees and Other Vegetation
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
591S-1	Dry Stack Rock Wall
610S-6	Typical Tree Well Applications

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 601S, "Salvaging and Placing Topsoil"</u>	

<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 102S	Clearing and Grubbing
Item No. 104S	Removing Concrete
Item No. 110S	Street Excavation
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 606S	Fertilizer
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
610S-1	Tree Protection Fence Locations
610S-2	Tree Protection Fence, Type B Chainlink
610S-3	Tree Protection Fence, Type B Wood
610S-4	Tree Protection Fence, Modified Type A
610S-5	Tree Protection Fence, Modified Type B
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-way
Item No. 110	Excavation
Item No. 160	Furnishing and Placing Topsoil
Item No. 164	Seeding for Erosion Control
Item No. 204	Sprinkling
<u>Texas Department of Transportation: Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-103-E	Determination of Moisture Content of Soil Materials
Tex-104-E	Determination of Liquid Limit of Soils
Tex-105-E	Determination of Plastic Limit of Soils
Tex-106-E	Method of Calculating the Plasticity Index of Soils

ITEM NO. 604S SEEDING FOR EROSION CONTROL 1-4-16

604S.1 Description

This item shall govern the preparation of a seed bed for temporary or permanent erosion control; sowing of seeds; fertilizing; mulching with straw, cellulose fiber wood chips, and recycled paper mulch; and other management practices along and across such areas as indicated in the Drawings or as directed by the Landscape Architect, Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

Source: Rule No. R161-14.29, 12-30-2014 ; Rule No. R161-15.14, 1-4-2016 .

604S.2 Submittals

The following submittal items are required in writing during construction:

- A. Identification of the seed species, source, mixture, and pure live seed (PLS) of the seed as listed on the analysis tags and certification tags from all seed bags. Seed calculation worksheet per Table 7. PLS is the percentage of seed purity multiplied by the percentage of germination, plus dormant seed. The analysis tag, required on all seed sold in Texas, includes information on quality: kind and variety of seed, lot number, percent pure live seed, percent other crop seed, percent inert matter, percent weed seeds, germination percentage, and date of test. The certification tag also verifies seed quality, an assurance of seed variety and attesting to standards for germination and purity. Information provided includes class of certification, kind of crop, variety, lot number, and name and address of the owner.
- B. If fertilizer is proposed, results of a recent soil test (6 months old or less) of the area to be seeded, before fertilization. Soil samples shall be collected after final grading, when topsoil has been placed. The test results must include soil lab recommended additions of Nitrogen (N), Phosphorus (P), and Potassium (K) for the type of vegetation proposed, as well as soil organic matter percentage and textural class.
- C. Fertilizer formulation and release rate based on a soil test (see B above).
- D. For hydromulch applications, proposed application rate of seed, type of mulch and tacking agent, and other relevant information. An example of the required documentation is in Table 1.
- E. Type of hydraulic seeding equipment and nozzles proposed for use.
- F. If pesticide use is proposed, an IPM plan for pest removal including pesticide label, proposed application rate and timing, and MSDS sheets.
- G. One gallon sample of proposed vegetative mulch.

The following submittal items are required before Substantial Completion:

- A. For hydromulch applications, the complete hydromulch application log, including date, time and quantity of product units placed in the slurry tank. An example of an application log is provided in Table 2. This log may be requested at any time during construction by the Landscape Architect, Engineer, designated representative, or authorized inspector.

- B. Pesticide application tracking log. As of January 1, 2012, documentation of all outdoor pesticide use on city-owned properties is required to demonstrate compliance with the EPA/TCEQ mandated Municipal Stormwater Permit, the TPDES General Pesticide Permit, City Code, and the IPM program.

Table 1: Example of proposed hydromulch application rates

				Hydro Slurry Unit (per acre rates)				
Hydro Mix	Sheet No.	Seed Mix	Acres	Seed (Bags/ac)	Tackifier (Buckets/ac)	Mulch (Bales/ac)	Fertilizer (Bags/ac)	Addl. Amendments (Bags/ac)
1	L2	A	1.0	1	100	1000	50	5
2	L3	A	0.5	2	200	1500	50	5
3	L5	B	3.0	3	300	3000	50	5

Table 2: Example of hydromulch application log

						Hydro Slurry Unit (per acre rates)				
Date	Start Time	Finish Time	ac/Tank	Water (gal)	Seed Mix	Seed (Bags/ac)	Tackifier (Buckets/ac)	Mulch (Bales/ac)	Fertilizer (Bags/ac)	Addl. Amendments (Bags/ac)
4/13	10:30	11:15	1.0	3300	A	1	100	1000	50	5
4/17	2:00	2:30	0.5	3300	A	2	200	1500	50	5
5/20	8:30	10:00	1.2	3300	B	3	300	3000	50	5
					Totals	6	600	5500	127	15

Source: Rule No. R161-14.29, 12-30-2014 ; Rule No. R161-15.14, 1-4-2016 .

604S.3. Materials

- A. **Seed.** All seed must meet the requirements of the Texas Seed Law including the labeling requirements for showing PLS, name and type of seed, and all other required elements of the Analysis and Certification Tags.

The seed furnished shall be of the previous season's crop and the date of analysis shown on each bag shall be within twelve (12) months of the time of delivery to the project. Each variety of seed shall be furnished and delivered in separate bags or containers, unless a specific mix is proposed for use. A sample of each variety of seed shall be furnished for analysis and testing when directed by the Landscape Architect, Engineer or designated representative.

The amount of seed planted per square yard (0.84 square meters) or acre (hectare [ha]) shall be of the type specified in Sections 604S.5 and 604S.6.

- B. **Water.** Water shall be clean and free of industrial wastes and other substances harmful to the growth of plant material or the area irrigated.
- C. **Topsoil.** Topsoil shall conform to Item No. 601S.3(A).
- D. **Fertilizer.** The fertilizer shall conform to Item No. 606S, Fertilizer. The type and rate of fertilizer should be based on chemical tests of recent (no older than 6 months before application) representative site soil samples. Fertilizer should be applied only when plants can take them up for growth, during: 1) seed

germination and plant establishment and 2) after plant establishment. Fertilizer shall not be applied within 48 hours of a potential rain event.

- E. **Straw Mulch or Hay Mulch.** Straw Mulch shall be oat, wheat or rice straw. Hay mulch shall be prairie grass, or other hay approved by the Landscape Architect, Engineer or designated representative. The straw or hay shall be free of Johnson grass or other noxious weeds and foreign materials. It shall be kept in a dry condition and shall not be moldy or rotted.
- F. **Tackifier.** The tackifier shall be a biodegradable tacking agent, approved by the Landscape Architect, Engineer or designated representative.
- G. **Cellulose Fiber Mulch (Natural Wood).** Cellulose Fiber Mulch shall be natural cellulose fiber mulch produced from grinding clean whole wood chips. The mulch shall be designed for use in conventional mechanical planting, hydraulic planting of seed or hydraulic mulching of grass seed, either alone or with fertilizers and other additives. The mulch shall be such, that when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.
- H. **Recycled Paper Mulch.** Recycled paper mulch shall be specifically manufactured from post-consumer paper and shall contain a minimum of 85% recycled paper content by weight, shall contain no more than 15% moisture and 1.6% ash, and shall contain no growth inhibiting material or weed seeds. The recycled paper mulch shall be mixed with grass seed and fertilizer (see "fertilizer" above) for hydro-seeding/mulching, erosion control, and a binder over straw mulch. The mulch, when applied, shall form a strong, moisture-retaining mat of a green color without the need of an asphalt binder.
- I. **Mulch.** Mulches, acting as seed coverings, can enhance seed germination and seedling establishment. Characteristics of ideal mulches for seeding are those that protect seeds from wind (drying), excessive solar radiation, high evapotranspiration rates, and erosion, while allowing germination and growth. Relatively coarsely shredded, weed-free vegetative mulch should be used on seed installations, especially in open, sunny areas. These materials shall be clean, free of foreign matter, and dry enough to spread evenly.
- J. **Pesticide.** A least toxic, integrated pest management (IPM) approach shall be used to control weeds. A written request for approval of weed control products and materials shall be submitted to the City of Austin Watershed Protection Department (ERM) IPM program coordinator for approval. Additional information can be found at <http://www.austintexas.gov/ipm>.

Source: Rule No. R161-14.29, 12-30-2014 ; Rule No. R161-15.14, 1-4-2016 .

604S.4 Construction Methods

- A. **General.** The Contractor shall limit preparation of the seedbed to areas that will be seeded immediately. When seeding for permanent erosion control, weed species listed in Table 3 shall be managed by application of an appropriate herbicide and/or by physical removal by the roots before the seeding operation. The goal of weed management is to facilitate establishment of the permanent vegetative cover. Additionally, the Owner may require removal of any plant species that appears to be out-competing seeded or planted species during the construction period.

Table 3: Weed List

Weed Type	Botanical Name	Common Name
Annual Grass	<i>Cenchrus spp.</i>	Sandbur
Herb	<i>Cnidocolus texanus</i>	Bull Nettle
Herb	<i>Urtica spp.</i>	Stinging Nettle
Vine	<i>Toxicodendron radicans</i>	Poison Ivy
Perennial Grass	<i>Sorghum halapense</i>	Johnson Grass

Perennial Grass	<i>Arundo donax</i>	Giant Cane
Perennial Grass	<i>Phyllostachys aurea</i>	Golden Bamboo
Summer Annual Herb	<i>Ambrosia trifida</i>	Ragweed
Winter Annual Herb	<i>Rapistrum rugosum</i>	Bastard Cabbage
Winter Annual Herb	<i>Bromus arvensis</i>	Japanese Brome
Winter Annual Herb	<i>Lolium multiflorum</i>	Annual Ryegrass

- B. **Preparing Seed Bed.** After the designated areas have been rough graded to the lines, grades and typical sections indicated in the Drawings or as provided for in other items of this contract and for any other soil area disturbed by the construction, a suitable seedbed shall be prepared. The seedbed shall consist of a minimum of either 6 inches (150 millimeters) of approved topsoil or 6 inches (150 millimeters) of approved salvaged topsoil.

The topsoil or growing medium must be prepared so that compaction is appropriate for plant growth, and to achieve acceptable bulk density or hydrologic function. Rippers and subsoilers may be used to loosen compacted soil and roughen the surface. Disks, plows and excavator attachments are good for compaction reduction, roughening and incorporating amendments. If tracked machinery is used in seedbed preparation, cleat marks should run with the contour to prevent rills. The optimum depth for seeding shall be 1/8 to 1/4 inch (3 to 6 millimeters).

Water shall be gently applied as required to prepare the seedbed prior to the planting operation either by broadcast seeding or hydraulic planting. Seeding shall be performed in accordance with the requirements described below.

- C. **Watering.** All watering shall comply with City Code Chapter 6-4 (Water Conservation). All seeded areas regardless of seed type and method of seeding (e.g., broadcast, hydroseed) shall be watered immediately after installation. For seed germination and establishment it is important to keep the seedbed in a moist condition favorable for the growth of plant materials.

Watering applications shall constantly maintain the seedbed in a moist condition favorable for the growth of plant materials. Watering shall continue until the plant material is at least 1 1/2 inches (40 mm) in height and accepted by the Engineer or designated representative. Supplemental watering can be postponed immediately after a half-inch (12.5 mm) or greater rainfall on the site but shall be resumed before the soil dries out.

- D. **Cool Season Cover Crop.** From September 15 to March 1, non-native and native seeding shall include a cool season cover crop at the rate specified in Table 6. Cool season cover crops are not permanent erosion control. If installed separately from the permanently erosion control seed mix, the cool season cover crops shall be mowed to a height of less than one (1) inch after March 1, and the area shall be re-seeded at the specified seeding rate for non-native or native warm-season species (March 1 to September 15).

Source: Rule No. R161-14.29, 12-30-2014 ; Rule No. R161-15.14, 1-4-2016 .

604S.5 Non-Native Seeding

- A. **Method A - Broadcast Seeding.** The seed or seed mixture in the quantity specified shall be uniformly distributed over the prepared seed bed areas indicated on the Drawings or where directed by the Engineer or designated representative. If the sowing of seed is by hand, rather than by mechanical methods, the seed shall be sown in two directions at right angles to each other. If mechanical equipment is used, all varieties of seed, as well as fertilizer (if required), may be distributed at the same time, provided that each component is uniformly applied at the specified rate. After planting, the planted area shall be rolled with a corrugated roller of the "Cultipacker" type. All rolling of the slope areas shall be on the contour.

Seed Mixture and Rate of Application for Broadcast Seeding:

From March 1 to September 15, seeding shall be with hulled Bermuda Grass at a rate of at least 45 lbs/ac (5.0 kilograms per hectare) with a minimum PLS = 0.83. Fertilizer shall be applied if warranted by a soil test, and shall conform to Item No. 606S, Fertilizer. Bermuda grass is a warm-season grass and is therefore considered permanent erosion control once established.

Method B - Hydraulic Planting. The seedbed shall be prepared as specified above and hydraulic planting equipment, which is capable of placing all materials in a single operation, shall be used. Information about hydromulching for temporary and permanent vegetation stabilization is in the Environmental Criteria Manual (ECM) Section 1.4.7. Hydroseeding equipment shall be clean and free of all previous seeds, fertilizer, mulch, or any hydroseeding products used on prior jobs.

From March 1 to September 15.

Hydraulic planting mixture and minimum rate of application pounds per acre or square yard (kilograms per ha):

Hulled Bermuda Seed (min. PLS=0.83)	Fiber Mulch		Soil Tackifier
	Cellulose	Wood	
45 lbs/ac (50.44 kg/ha)	2000 lbs/ac (2242 kg/ha)		60.98 lbs/ac (68.36 kg/ha)
		2500 lbs/ac (2803 kg/ha)	65.34 lbs/ac (73.25 kg/ha)

Source: Rule No. R161-14.29, 12-30-2014 ; Rule No. 161-15.14, 1-4-2016 .

604S.6 Native Grass and Forb Seeding

The seed mixture shall include both grasses and forbs. The dry and moist sites grass mix shall be seeded at rates of at least 23.5 and 17.0 lb/ac (26.32 and 19.04 kg/ha), respectively and the dry and wet site forb mix shall be seeded at a rate of at least 11.5 and 9.0 lb/ac (12.88 and 10.08 kg/ha), for total application rates of 35.00 lb/ac (39.20 and 29.12 kg/ha) [dry site] and 26 lb/ac (29.12 kg/ha) [wet site]. Minimum diversity for dry sites (Table 4) is eight species of grasses and 10 species of forbs. Minimum diversity for wet sites (Table 5) is six species of grasses and seven species of forbs. The species indicated with an asterisk shall be included in all proposed mixes. Application rates may be modified, but no species shall constitute more than 20% of a seed mix. Any species proposed for installation and not included in Tables 4 or 5 shall be by City of Austin representative including Environmental Reviewer, Environmental Inspector, or Watershed Protection Department representative, and shall be native to Central Texas as referenced by the LBJ Wildflower Center plant database (www.wildflower.org) or USDA plant database.

Table 4: Native Grasses and Forbs: Dry Sites

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				lbs/ac	kg/ha
Grass Seed Mix	Sideoats grama*	<i>Bouteloua curtipendula</i>	Full-part sun	7.0	7.8
	Green sprangletop*	<i>Leptochloa dubia</i>	Full sun	6.0	6.7
	Buffalograss	<i>Buchloe dactyloides</i>	Full sun	24.0	27.0
	Blue Grama Grass	<i>Bouteloua gracilis</i>	Full-part sun	10.0	11.2
	Canada Wild Rye	<i>Elymus canadensis</i>	Full-part sun	10.0	11.2
	Purple Three-Awn	<i>Aristida purpurea</i>	Full sun	4.0	4.5
	Cane Bluestem	<i>Bothriochloa barbinodis</i>	Full sun	3.0	3.3

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	Galleta	<i>Pleuraphis jamesii</i>	Full sun	10.0	11.2
	Black Grama*	<i>Bouteloua eripoda</i>	Full sun	10.0	11.2
	Sand Dropseed*	<i>Sporobolus cryptandrus</i>	Full sun	1.0	1.1
	Alkali Sacaton	<i>Sporobolus airoides</i>	Full sun	0.5	1.7
	Curly Mesquite	<i>Hilaria belangeri</i>	Full sun	2.0	2.2
	Sand Lovegrass	<i>Eragrostis trichodes</i>	Full sun	2.0	2.2
	Black-Eyed Susan	<i>Rudbeckia hirta</i>	Full-part sun	2.0	2.2
	Illinois Bundleflower*	<i>Desmanthus illinoens</i> (legume)	Full-part sun shade	15.0	16.8
	Scarlet Sage	<i>Salvia coccinea</i>	Full-part sun shade	8.0	9.0
	Pink Evening Primrose	<i>Oenothera speciosa</i>	Full-part sun shade	1.0	1.1
	Drummond Phlox	<i>Phlox drummondii</i>	Full-part sun	8.0	9.0
	Plains Coreopsis	<i>Coreopsis tinctoria</i>	Full-part sun	2.0	2.2
	Greenthread	<i>Thelesperma filifolium</i>	Full sun	6.0	6.7
	Purple Prairie Clover*	<i>Dalea purpurea</i>	Full sun	4.0	4.5
	Cutleaf Daisy	<i>Engelmannia pinnatifida</i>	Full-part sun	18.0	20.1
Forb Seed Mix	Partridge Pea*	<i>Chamaecrista fasciculata</i>	Full-part sun	20.0	22.4
	Indian Blanket	<i>Gaillardia pulchella</i>	Full-part sun	10.0	11.2
	Bluebonnet*	<i>Lupinus texensis</i> (legume)	Full sun	20.0	22.4
	Mexican Hat	<i>Ratibida columnaris</i>	Full-part sun	2.0	2.2
	Maximilian Sunflower	<i>Helianthus maximiliana</i>	Full-part sun	5.0	5.6
	Prairie Coneflower	<i>Ratibida columnifer</i>	Full-part sun	2.0	2.2
	Clasping Coneflower	<i>Dracopis amplexicaulis</i>	Full-part sun	3.0	3.4
	Purple Coneflower	<i>Echinacea purpurea</i>	Full-part sun shade	10.0	11.2
	Lemon Mint	<i>Monarda citriodora</i>	Full-part sun	3.0	3.4
	Huisache Daisy	<i>Amblyolepis setigera</i>	Full-part sun	8.0	9.0
	Texas Yellow Star	<i>Lindheimeria texana</i>	Full-part sun	12.0	13.5
	Lanceleaf Coreopsis	<i>Coreopsis lanceolata</i>	Full-part sun shade	10.0	11.2
	Bush Sunflower	<i>Simsia calva</i>	Full-part sun	3.0	3.4
	Winecup	<i>Callirhoe involucrata</i>	Full-part sun shade	5.0	5.6
	Antelope horns	<i>Asclepias asperula</i>	Full sun	0.1	0.04
	Green milkweed	<i>Asclepias viridis</i>	Full sun	0.1	0.04
TOTAL					
Total seed mix application rate is 35.0 lb/ac (23.5 lb/ac grasses and 11.5 lb/ac forbs), to be composed of at least 8 species from the grass list and 10 species from the forb list to include the required species.					

*Required species that must be included in the mix

Table 5: Native Grasses and Forbs: Wet Sites

Type	Common Name	Botanical Name	Exposure	Recommended Application Rates	
				lbs/ac	kg/ha
Grasses	White Tridens	<i>Tridens albescens</i>	Full-part sun	0.5	0.56

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	Plains Bristlegrass	<i>Setaria leucopila</i>	Full-part sun	6.0	6.7
	Switchgrass	<i>Panicum virgatum</i>	Full-part sun	4.0	4.5
	Inland Sea Oats	<i>Chasmanthium latifolium</i>	Shade	12.0	13.5
	Canada Wild Rye	<i>Elymus canadensis</i>	Full sun - shade	10.0	11.2
	Big Bluestem	<i>Andropogon gerardii</i>	Full sun	4.0	4.5
	Bushy Bluestem	<i>Andropogon glomeratus</i>	Full sun	3.0	3.4
	Green Sprangletop*	<i>Leptochloa dubia</i>	Full sun	2.0	2.2
	Eastern Gamagrass	<i>Tripsacum dactyloides</i>	Full sun - shade	3.0	3.4
Forb Seed Mix	American Basketflower	<i>Centaurea americana</i>	Full sun	10.0	11.2
	Common milkweed	<i>Asclepias syriaca</i>	Full sun	0.1	0.04
	Butterfly weed	<i>Asclepias tuberosa</i>	Full sun	0.1	0.04
	Blue Mistflower	<i>Conoclinium coelestinum</i>	Full-part sun	0.5	0.6
	Clasping Coneflower	<i>Dracopsis amplexicaulis</i>	Full-part sun	3.0	3.4
	Maximilian Sunflower	<i>Helianthus maximiliani</i>	Full-part sun	4.0	4.5
	Prairie Blazing Star	<i>Liatris pycnostachya</i>	Full sun	2.0	2.2
	Pink Evening Primrose	<i>Oenothera speciosa</i>	Full sun-dappled shade	1.0	1.1
	Mexican Hat	<i>Ratibida columnifera</i>	Full-part sun	2.0	2.2
	Black-eyed Susan	<i>Rudbeckia hirta</i>	Full sun-dappled shade	2.0	2.2
	Illinois Bundleflower	<i>Desmanthus illinoensis</i>	Full sun-dappled shade	15.0	16.8
	Obedient Plant	<i>Physostegia virginiana</i>	Full sun-dappled shade	4.0	4.5
	Partridge Pea*	<i>Camaecrista fasciculata</i>	Full-part sun	20.0	22.4
	Purple Prairie Clover	<i>Dalea purpurea var purpurea</i>	Full sun	4.0	4.5
	Pitcher Sage	<i>Salvia azurea</i>	Full-part sun	3.0	3.4
	Showy Tick Trefoil	<i>Desmodium canadense</i>	Full sun	0.5	0.6
Winecup*	<i>Callirhoe involucrata</i>	Full-part sun	5.0	5.6	
TOTAL					
Total seed mix application rate is 26.0 lb/ac (17.0 lb/ac grasses and 9.0 lb/ac forbs), to be composed of at least 8 species from the grass list and 10 species from the forb list to include the required species.					

Table 6: Cool Season Cover Crop

Common Name	Botanical Name	Exposure	Application rates	
			lbs/ac	kg/ha
Western Wheatgrass	<i>Pascopyrum smithii</i>	Full-pt sun; dappled shade	5.6	6.28
Oats	<i>Avena sativa</i>	Full sun	4.0	4.48
Cereal Rye Grain	<i>Secale cereale</i>	Full sun	34.0	38.11

One cover crop species of the listed species is required to be planted between September 15 to March 1. Contractor must ensure that any seed application requiring a cool season cover crop does not utilize annual ryegrass (*Lolium multiflorum*) or perennial ryegrass (*Lolium perenne*). Only cereal rye grain (*Secale cereale*), oats (*Avena sativa*) and western wheatgrass (*Pascopyrum smithii*) are approved as cool season cover crop.

Species substitution as necessary due to availability shall be approved by the Landscape Architect, Engineer or designated representative. Watering and fertilizer application shall follow procedures outlined above or as otherwise specified on the Drawings.

Seed shall be applied by broadcast, hydromulch, blown compost, or drill method and shall be distributed evenly over the topsoil areas. Mulching shall immediately follow seed application for broadcast and hydromulch applications.

Seed Rate Calculations

The amount of seed needed to be planted on a project shall be calculated before installation to ensure adequate seed is placed, and provided as a submittal. Table 7 is an example worksheet, followed by an example calculation. Information for calculation can be obtained from seed tags or the supplier.

Table 7. Seed Calculation Worksheet

Plant Group	Desired Seeding Rate (lbs/ac)	PLS (pure live seed)	Bulk Rate (lbs/ac)	Seeding Area (ac)	Amt. of Seed to be Installed (lbs)
Grasses					
Forbs					
TOTAL					

FORMULAS:

PLS (pure live seed) = (Purity × Germination) × 100. Can also use average PLS from seed tags.

Bulk Rate (lbs/ac) = Desired Seed Rate (lbs/ac) / PLS

Amt. of Seed to be Installed (lbs) = Bulk Rate (lbs/ac) × Seeding Area (ac)

Example:

Plant Group	Desired Seeding Rate (lbs/ac)	PLS [pure live seed] (% decimal)	Bulk Rate (lbs/ac)	Seeding Area (ac)	Amt. of Seed to be Installed (lbs)
Grasses	131.00	0.81	161.73	1.50*	242.60
Forbs	65.34	0.87	75.10	1.50*	112.70
TOTAL	196.34	0.84 (ave.)	236.83	1.50	355.30

*applied over the same 1.5 ac area

Source: Rule No. R161-14.29, 12-30-2014 ; Rule No. R161-15.14, 1-4-2016 .

604S.7 Mulch

Mulches may be used to help prevent soil erosion until final stabilization is achieved. Mulch shall be used to cover broadcasted seeds, especially in sunny, open areas, to protect them from drying out during germination.

A. **Straw Mulch.**

Straw mulch shall be spread uniformly over the area indicated or as designated by the Engineer or designated representative at the rate of 2 to 2½ tons of straw per acre (4.5 to 5.6 megagrams of straw per hectare). The actual rate of application will be designated by the Landscape Architect, Engineer or designated representative. Straw may be hand or machine placed and adequately secured.

B. **Hydromulch.**

Refer to ECM Section 1.4.7 for hydromulching applications.

C. **Shredded Brush Mulch.**

Small brush or tree limbs, which have been shredded, may be used for mulching Native Grass seeding.

Source: Rule No. R161-14.29, 12-30-2014 .

604S.8 Management Practices

Management Practices include (1) weed management (pesticide application or mechanical removal) to so that 90 percent of the revegetation area is free of weeds listed in Table 3, and (2) reseeding areas of poor germination to achieve coverage and height per 604S.9, with no bare areas greater than 10 s.f.

Ninety (90) percent of a permanent revegetation area must be free of weeds listed in Table 3. Weeds shall be controlled in the most efficient manner possible. Management of weed species should begin early in the project, before seeding for permanent control, and extend into plant establishment, especially for perennial weeds. Manual removal or application of an appropriate herbicide may be required after the initial seeding if emergence of an annual weed species threatens establishment of sufficient preferred plant cover. Disturbance due to weed management after the initial seeding may necessitate re-seeding of the area to establish sufficient preferred plant coverage. Care should be taken to temporarily stabilize areas where physical removal of weeds has been performed to prevent erosion and sediment runoff.

The entire root system of perennial weeds shall be removed to prevent re-sprouting. Weeds may be controlled with an approved contact, systemic herbicide, provided the product is used with appropriate care and is applied in accordance with label instructions and the following guidelines:

1. Herbicide shall not be applied when the wind is greater than 8 mph (12.9 kph),
2. Herbicide shall not be applied when rainfall is expected within 24 hours,
3. Herbicide shall not contact surface water, i.e. creeks, rivers, and lakes,
4. Herbicide shall not contact desirable vegetation (a wicking method shall be used, if necessary, to accurately contact target weed only during application).

The Landscape Architect, Engineer or designated representative shall be consulted to determine appropriate weed control management when weeds are located in an environmentally sensitive location (e.g. near water or adjacent to a critical environmental feature).

At locations that fail to show an acceptable stand of planting for any reason during the initial seeding, repair and/or reseed locations as determined by the Landscape Architect, Engineer or designated representative. A successful stand of grasses and forbs for erosion control should exhibit the following:

- Seedlings with vigorous green foliage;
- Green leaves remaining throughout the summer, at least at the plant bases;
- Uniform density, with grasses and/or forbs well intermixed;

- Minimum of 95% cover; and
- No exposed soil greater than 10 s.f. in aerial extent.

The Contractor shall meet the requirements of the initial seeding, including seeding method, seed mix, and application rates, unless otherwise agreed to in writing by the Owner. Corrected deficiencies will be re-inspected and approved by the Owner, and final acceptance will be granted upon satisfactory completion.

Source: Rule No. R161-14.29, 12-30-2014 ; Rule No. R161-15.14, 1-4-2016 .

604S.9 Measurement

Work and acceptable material for Seeding for Erosion Control will be measured by the square yard (meter: 1 meter equals 1.196 square yards) or by the acre (hectare: 1 hectare equals 2.471 acres), complete in place so that all areas of a site that rely on vegetation for stability must be uniformly vegetated with a minimum of 95 percent total coverage for the non-native or native mixes. Bare areas shall not exceed 16 square feet (1.5 square meters), and the average height of vegetation shall stand at a minimum of 1½ inch (40 millimeters). Ninety (90) percent of the re-vegetated area, whether native or non-native re-vegetation, must be free of weeds listed in Table 3. Bare areas greater than 10 s.f. shall be re-prepared and reseeded as required to develop an acceptable stand of plant material.

Source: Rule No. R161-14.29, 12-30-2014 ; Rule No. R161-15.14, 1-4-2016 .

604S.10 Payment

The work performed and materials furnished and measured will be paid for at the unit bid price for Seeding for Erosion Control of the method specified on the Drawings and type of mulch. The unit bid price shall include full compensation for furnishing all materials, including all topsoil, water, seed, tackifier, fertilizer or mulch and for performing all operations necessary to complete the work.

All fertilizer will be measured and paid for conforming to Item No. 606S, Fertilizer.

Payment will be made under one of the following:

Pay Item No. 604S-A:	Non-Native Seeding for Erosion Control Method, Hydraulic Planting Per Square Yard	
Pay Item No. 604S-B:	Non-Native Seeding for Erosion Control, Broadcast Seeding, Per Square Yard	
Pay Item No. 604S-C:	Non-Native Seeding for Erosion Control Method, Hydraulic Planting Per Acre	
Pay Item No. 604S-D:	Native Seeding for Erosion Control Method, Hydraulic Planting Per Square Yard	
Pay Item No. 604S-E:	Native Seeding for Erosion Control, Broadcast Seeding, Per Square Yard	
Pay Item No. 604S-F:	Native Seeding for Erosion Control Method, Hydraulic Planting Per Acre	
Pay Item No. 604S-G:	Mulch, Per Square Yard	
Pay Item No. 604S-H:	Mulch, Per Acre	
Pay Item No. 604S-I:	Topsoil and Seedbed Preparation, Per Square Yard	
Pay Item No. 604S-J:	Topsoil and Seedbed Preparation, Per Acre	
Pay Item No. 604S-K:	Watering, Per 1000 gal (Kgal)	
Pay Item No. 604S-L:	Management Practices, Per Square Yard	

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Pay Item No. 604S-M:	Management Practices, Per Acre	
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End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification Item 604S Seeding for Erosion Control</u>	
<u>City of Austin Technical Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 130S	Borrow
Item No. 601S	Salvaging and Placing Topsoil
Item No. 606S	Fertilizer
<u>City of Austin Land Development Code</u>	
<u>Designation</u>	<u>Description</u>
Section 6-4	Water Conservation

RELATED CROSS REFERENCE MATERIALS	
<u>Specification Item 604S Seeding for Erosion Control</u>	
<u>City of Austin Technical Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 601S	Salvaging and Placing Topsoil
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 607S	Slope Stabilization
Item No. 608S	Planting
<u>City of Austin Standards (Details)</u>	
<u>Designation</u>	<u>Description</u>
627S-1	Grass Lined Swale
633S-1	Landgrading
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 160	Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 180	Wildflower Seeding
Item No. 192	Landscape Planting

ITEM NO. 605S SOIL RETENTION BLANKET 6-21-07**605S.1 Description**

This item shall govern the provision and placement of wood, straw or coconut fibert mat, synthetic mat, paper mat, jute mesh or other material as a soil retention blanket for erosion control on slopes or ditches or short-term or long-term protection of seeded or sodded areas indicated on the Drawings or as specified by the Engineer or designated representative.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, inch-pound units are given preference with SI units shown within parentheses.

605S.2 Submittals

The submittal requirements for this specification item shall include the soil retention blanket material type and sample, evidence that the material is listed on TxDOT/TTI Approved Products List, one (1) full set of Manufacturer's literature and installation recommendations, and any special details necessary for the proposed application.

605S.3 Materials**A. Soil Retention Blankets.**

All soil retention blankets must be listed on TxDOT Approved Products List or approved by the Engineer or designated representative.

The soil retention blanket shall be one (1) of the following classes and types as shown on the Drawings:

1. Class 1. Slope Protection
 - (a) Type A Slopes 3:1 or flatter - Clay soils
 - (b) Type B Slopes 3:1 or flatter - Sandy soils
 - (c) Type C Slopes steeper than 3:1 - Clay soils
 - (d) Type D Slopes steeper than 3:1 - Sandy soils
2. Class 2. Flexible Channel Liner
 - (a) Type E Short-term duration (Up to 2 years)
Shear Stress (t_d) < 2.0 pound per square foot [psf]
 - (b) Type F Short-term duration (Up to 2 years)
Shear Stress (t_d) ≤ 4.0 psf
 - (c) Type G Long-term duration (Longer than 2 years)
Shear Stress (t_d) ≤ 6.0 psf
 - (d) Type H Long-term duration (Longer than 2 years)
Shear Stress (t_d) ≤ 8.0 psf

B. Fasteners

The fasteners shall conform to the recommendations of the manufacturer for the selected soil retention blanket.

Source: Rule No. R161-14.29, 12-30-2014 .

605S.4 Construction Methods

A. General.

The soil retention blanket shall conform to the class and type shown on the Drawings. The Contractor has the option of selecting an approved soil retention blanket conforming to the class and type shown on the Drawings which is included on the Approved Products List published by TxDOT/TTI Hydraulics and Erosion Control Laboratory.

B. Site Preparation.

Prior to placement of the soil retention blanket, the seedbed area to be covered shall be relatively free of all clods and rocks over 1 ½ inches (37.5 mm) in maximum dimension and all sticks or other foreign matter that will prevent close contact of the preparation mat with the soil surface. The area shall be smooth and free of ruts and other depressions. If the prepared seedbed becomes crusted or eroded as a result of rain or if any eroded places, ruts or depressions exist for any reason, the Contractor shall be required to rework the soil until it is smooth and to reseed or resod the area at the Contractor's own expense. After the area has been properly prepared, the blanket shall be laid out flat, even and smooth, without stretching or crimping the material.

C. Installation.

The Soil Retention Blanket, whether installed as slope protection or as flexible channel liner in accordance with the TxDOT/TTI Approved Products List, shall be placed within 24 hours after seeding (Standard Specification Item No. 604S), sodding (Standard Specification Item No. 602S) or native grassland seeding and planting (Standard Specification Item No. 609S) erosion control operations have been completed, or as approved by the Engineer or designated representative. The soil retention blanket shall be installed and anchored in accordance with the Manufacturer's recommendations. The Contractor shall contact the Engineer or designated representative three (3) days prior to the installation of the soil retention blanket to allow for inspection of the installation by City of Austin personnel.

605S.5 Measurement

This work and acceptable material for "Soil Retention Blanket" will be measured by the square yard (square meter: 1 square meter is equal to 1.196 square yards) of surface area covered, complete in place.

605S.6 Payment

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit bid price for "Soil Retention Blanket" of the class shown on the Drawings or approved by the Engineer or designated representative. The unit price shall include full compensation for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work. Anchors, checks, terminal and wire staples will not be paid for directly, but will be included in the unit price bid for this specification item.

Payment will be made under the following:

Pay Item No. 605S-A:	Soil Retention Blanket Class ___; Type ___	Per Square Yard.
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End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 605S, "Soil Retention Blanket"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 602S	Sodding for Erosion Control
Item No. 604S	Seeding for Erosion Control
Item No. 609S	Native Grassland Seeding and Planting for Erosion Control

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 605S, "Soil Retention Blanket"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right-of-Way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-Way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 162	Sodding for Erosion Control
Item No. 164	Seeding for Erosion Control
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 610S PRESERVATION OF TREES AND OTHER VEGETATION 12-7-18

610S.1 Description and Definitions

This item shall govern the proper care, protection and treatment of trees and other vegetation in the vicinity of the permitted development activity (as defined in Land Development Code 25-1-21(27)). All work shall be performed in accordance with the City approved drawings and specifications (e.g. Standard Series 600) or as approved by the City Arborist (as defined below). Tree pruning and/or treatments shall be performed under the direct supervision of a qualified arborist (as defined below) or as allowed by the City Arborist.

Definitions

City Arborist - City official designated by the Director of the Planning and Development Review Department (Land Development Code 25-8-603) or as designated by the City Arborist.

Oak wilt - a tree disease caused by a fungus "Ceratocystis fagacearum" that infects the vascular system of Oak "genus Quercus" trees and prevents water transport through the trunk and canopy of the tree. This usually fatal tree disease can be spread by certain insects that come into contact with tree wounds or by interconnected tree roots. February through June is a high risk period due to the stage of the fungus and insect activity. See section 610S.4(H) for additional requirements for preventing Oak wilt infection.

Qualified Arborist - an individual engaged in the profession of arboriculture or closely related field who, through experience, education, and related training, possesses the competence to provide for, or supervise, the management of trees and other woody plants (as defined in the most current version of ANSI A300 (Part 1)-2001, section 4.1).

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text and accompanying tables, the inch-pound units are given preference followed by SI units shown within parentheses.

610S.2 Submittals

The following is a list of the minimum submittal requirements for this specification item shall include:

- A. Identification of the location, type of protective fencing (i.e. A, B or C), materials of construction and installation details;
- B. Qualified Arborist credentials (i.e. proof of certification from the International Society of Arboriculture, licenses, resume and/or references);
- C. Type, location and construction details for proposed tree wells;
- D. Location, type, materials of construction and installation details for permeable paving;
- E. Proposed nutrient mix specifications and when required by the City Arborist, soil and/or foliar analysis for fertilizer applications.

610S.3 Materials

- A. Protective Fencing and Signage

Protective fencing is designated as the materials used to protect the root zones of trees as illustrated in City of Austin Standard Detail 610S-1. Three basic types of protective fencing materials are allowed by the City of Austin. Type A and Type B are typical applications and shall be installed where damage potential to a tree

root system is high, while Type C shall be installed where damage potential is minimal. The specific type of protective fencing for the work shall be as indicated on the drawings. Type C fence materials shall be subject to approval by the City Arborist. Type C fencing shall be replaced by Type A or Type B fencing as directed by the City Arborist if it fails to perform the necessary function.

1. Type A Chain Link fence (Typical Application-high potential damage)

Type A protective fencing shall be installed in accordance with City of Austin Standard Details 610S-2 and 610S-4 and shall consist of a minimum five-foot (1.5 meters) high chain link fencing with tubular steel support poles or "T" posts.

2. Type B Wood Fence (Typical Application-high potential damage)

Type B protective fencing shall be installed in accordance with City of Austin Standard Details 610S-3 and 610S-5 and shall consist of any vertical planking attached to 2x4-inch (50 x 100 mm) horizontal stringers which are supported by 2x4-inch (50 x 100 mm) intermediate vertical supports and a 4x4-inch (100 x 100 mm) at every fourth vertical support .

3. Type C Other Materials (Limited Application-minimal potential damage)

The following materials may be permitted as alternates for limited or temporary applications (3 days or less) where tree damage potential is minimal (as determined by the City Arborist):

(a) High visibility plastic construction fencing.

The fabric shall be 4 feet (1.2 meters) in width and made of high density polyethylene resin, extruded and stretched to provide a highly visible international orange, non-fading fence. The fabric shall remain flexible from -60°F to 200°F (-16°C to 93°C) and shall be inert to most chemicals and acid. The fabric pattern may vary from diamond to circular with a minimum unit weight of 0.4 lbs./Ft. (0.6 kilograms per meter).

The fabric shall have a 4 foot (1.2 meters) width minimum tensile yield strength (Horizontal) of 2000 psi [13.9 megaPascals], ultimate tensile strength of 2680 psi [18.5 megaPascals] (Horizontal) and a maximum opening no greater than 2 inches (50 mm).

(b) Other approved equivalent restraining material.

The fencing materials, identified in (a) and (b) above, shall be supported by steel pipe, tee posts, U posts or 2" x 4" (50 mm x 100 mm) timber posts that are a minimum of 5½ feet (1.68 meters) in height and spaced no more than 8 feet (2.44 meters) on centers. The fabric shall be secured to post by bands or wire ties.

4. Signage

A laminated sign, no smaller than 8.5 X 11 inches, shall be posted on each tree protective device, and at least every 100 linear feet on protective fencing, identifying the following information: Tree & Root Protection Zone, Per City of Austin code (Chapter 25-8, Subchapter B, Article 1) this protective device is to remain in place for the entirety of the development project and illegal removal is subject to fines and work suspensions. Additional information can be obtained at the City Arborist (512-974-1876) web site (<http://www.ci.austin.tx.us/trees>). Zona de Protección del Árbol y las Raíces: el dispositivo protector debe quedarse en el lugar para la totalidad del proyecto de la construcción. Para información adicional, contacta la Arborista Municipal (512) 974-1876 o http://www.ci.austin.tx.us/trees/trees_spanish.htm.

B. Trunk Protection (Limited Application)

When indicated on the drawings or directed by the City Arborist tree trunk protection shall be provided in accordance with City of Austin Standard Details 610S-4 and 610S-5. Tree trunk protection shall consist of any

2 x 4-inch (50 x 100 mm) or 2 x 6-inch (50 x 150 mm) planking or plastic strapping and shall be attached in a manner that does not damage the tree.

C. Tree Dressing

Wound treatments should not be used to cover wounds or pruning cuts, except when recommended for disease (see section 610S.4 (H)), insect, mistletoe, or sprout control (from ANSI A300 (Part 1)-2001, section 5.4.1).

D. Tree Wells for Raised Grades

When existing grades are raised by more than 4 inches (10.16 cm), the tree root system shall be protected by the installation of tree wells in accordance with City of Austin Standard Detail 610S-6. Native stone or non-toxic timber shall be used for the separator wall of the well and PVC conforming to ASTM D-2729, SDR-35 shall be used for the aeration systems in fill areas.

E. Permeable Paving (Environmental Criteria Manual Section 3.5.A.1)

Permeable segmented pavers in conjunction with PVC pipe aeration system or concrete on gravel base with cored holes shall be used to protect existing tree root zones when indicated on the drawings or directed by the City Arborist.

F. Fertilizer

Humate/nutrient solutions with mycorrhizae components or soil injection at recommended rates are to be used when appropriate. Construction which will be completed in less than 90 days may use materials at half the recommended rates. Alternative organic fertilizer materials are acceptable when approved by the City Arborist.

610S.4 Construction Methods

A. Protective Fencing

All trees and shrubs in the proximity of the construction site shall be carefully checked for damage prior to initiation of the permitted development activity.

All individual or groups of trees, shrubs, and natural areas shown to be protected on the drawings or identified to be protected by the City Arborist, shall be protected during construction with temporary fencing as indicated on the drawings or as directed by the City Arborist.

Protective fences (section 610S.4.A) shall be installed prior to the start of any site preparation work (clearing, grubbing, or grading), and shall be maintained in functioning condition throughout all phases of the construction project.

Protective fence locations in close proximity to intersecting streets or drives shall adhere to the sight distance (Section 1.3.1.C.6) and desirable sight triangle (Figure 1-6 criteria found in the City of Austin Transportation Criteria Manual).

1. Protective fences shall be constructed at the locations (typically the outer limits of the critical root zone) and with materials indicated on the drawings to prevent the following (Environment Criteria Manual, Appendix P-2, Note 6):
 - (a) Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment or materials.
 - (b) Critical root zone disturbances due to grade changes [greater than 4" (10.16 cm) cut or fill] or trenching not reviewed and authorized by the City Arborist.
 - (c) Damage to exposed roots, trunks or limbs by mechanical equipment.

-
- (d) Other activities detrimental to trees such as chemical storage, concrete truck cleaning, and fires.
2. Exceptions to the installation of protective fences at the tree drip lines may be permitted in the following cases:
- (a) Where there is to be an approved grade change, impermeable paving surface, tree well, or other such site development, the fence shall be erected no more than 2 feet (0.6 meters) beyond the area of disturbance unless approved by the City Arborist;
 - (b) When permeable paving is to be installed within a tree's critical root zone, the fence shall be erected at the outer limits of the permeable paving area (prior to any site grading so that this enclosed area is graded separately to minimize root damage);
 - (c) When trees are located close to a proposed building or other construction activity (Environment Criteria Manual, Appendix P-2, Note 6.c), the fence shall be erected up to 10 feet (3 meters) to allow work space between the fence and the structure. Apply organic mulch to a depth of 8 inches [30.48 cm] in the unprotected root zone area;
 - (d) When there are street-side pedestrian walkways, fences shall be constructed in a manner that does not obstruct safe passage;
 - (e) When there are severe space constraints due to tract size or other special requirements, the Contractor shall contact the City Arborist to discuss alternatives.

When any of the exceptions listed above will result in a fence being located closer than five (5) feet (1.5 meters) to a tree trunk, the Contractor shall also protect the trunk with strapped-on planking to a height of 8 feet [2.4 meters] (or to the limits of lower branching) in addition to the fencing requirement (City of Austin Standard Details 610S-4 and 610S-5).

B. Pruning and Repair of Damage

Tree pruning, to provide clearance for the work and/or to remove hazards, shall be performed under the direct supervision of a qualified arborist and shall follow standards identified in ANSI A300 (Part 1), "Pruning". A minimum clearance height of eight (8) feet (2.4 meters) above the street level must be provided and maintained for all existing trees if adjacent to a sidewalk. However, if the limbs of trees overhang the curb line or edge of travel lane of any street, a minimum clearance height of fourteen (14) feet (4.2 meters) is required (Transportation Criteria manual section 6.2.3,A, 4, "Clearance Height"). Pruning shall provide the minimum clearance needed to perform the work or remove a hazard unless otherwise directed by the City Arborist to comply with transportation criteria or to mitigate for damage.

If tree damage compromises a tree's structural integrity then the area shall be adequately secured until a qualified arborist makes an assessment of the tree and corrective actions are completed with approval from the City Arborist. Damage to oak trees shall be treated immediately, with consideration for site safety, to reduce the risk of Oak Wilt infection (See 610S.4.H, "Oak Wilt Prevention"). Tree root wounds shall be treated to remove loose, damaged tissue from in and around the wound or if necessary the root shall be cut cleanly and covered with topsoil, or other material approved by the City Arborist, to prevent drying of root tissue and to create a favorable environment for root sprouting. Trunk wounds shall also be treated to remove loose, damaged tissue around the wound. Tree canopy repairs shall be performed in accordance with the most current version of ANSI A300 (Part 1), "Pruning", to prevent further damage to the tree and to promote recovery of the tree to sound condition. The ANSI standard describes proper pruning methods for limb removal and for making finish pruning cuts.

Trees damaged or removed without prior approval or where minimum design criteria is exceeded due to failure to maintain approved tree protection shall be mitigated (Environmental Criteria Manual section 3.5.4, "Mitigation Measures") in accordance with Land Development Code Chapter 25-8, Subchapter B, Article 1.

All trees damaged during construction shall receive an application of fertilizer within the drip line conforming to Standard Specification Item No. 606S, "Fertilizer" at the rate of 4 pounds per caliper inch (.07 kilograms per caliper mm).

C. Cutting and Filling Around Trees

When the depth of an excavation or embankment exceeds 4 inches (10.16 cm) within the critical root zone of any tree with a trunk diameter greater than 8 inches (200 mm), the City Arborist may require a tree well to be constructed per the City of Austin approved specifications and details (Section 610S.3.D and City of Austin Standard Detail 610S-6).

D. Paving Around Trees

Where new paving within the ½ critical root zone of any tree greater than a 8 inches (10.16 cm) diameter is approved, a permeable pavement and aeration system may be required by the City Arborist per the City of Austin Standard Detail (Section 610S.3.E, Environmental Criteria Manual Section 3.5.3.A.1 and Figure 3-8) must be installed as indicated on the Drawings, except for street construction.

E. Tree Removal

Tree removal shall comply with Land Development Code Chapter 25-8, Subchapter B, Article 1. An approved permit, or an approved site plan is required for removal of trees 8" and larger (see Environmental Criteria manual section 3.3.2.A.2 and figure 3-1 for measurement standards) with additional requirements for City Parkland properties and for Hill Country Roadway Corridor sites. Trees 19 inches in diameter and greater are defined as protected trees and require specific review from the City Arborist to approve a permit or site plan for removal. In addition heritage trees require a more extensive evaluation by the City Arborist and may require rulings from boards and commissions.

All trees to be removed shall be performed in a manner that does not damage the canopies, trunks or root systems of remaining trees and that protects all existing facilities, improvements and vegetation. Removal of oak trees shall follow the Oak Wilt Prevention procedures per the City of Austin Standards (Section 610S.4,(H)). All tree material shall be removed from the site unless authorized by the City Arborist or if it will be used as wood chips or mulch.

When a tree or shrub is scheduled for removal, it shall be cut to a maximum depth of 12 inches (30.5 cm) below the surrounding grade (the tree(s) should be removed at grade, and with hand saws, in situations where other tree root systems are present which are to be preserved). When applicable, after tree removal, soil shall be placed in the hole to a depth matching the existing grade.

All damage resulting from tree removal or pruning shall be repaired at the Contractor's own expense and shall follow guidelines in this specification.

F. Final Cleanup

All temporary tree and shrub preservation and protection measures shall be removed when the construction has been completed and any mulch applications shall be removed or reduced to no more than 3 inches (7.62 cm) depth.

G. Root Zone Aeration and Fertilization

As a component of an effective remedial tree care program per Environmental Criteria Manual section 3.5.4, preserved trees within the limits of construction may require soil aeration and supplemental nutrients. Soil and/or foliar analysis should be used to determine the need for supplemental nutrients. The City Arborist may require these analyses as part of a comprehensive tree care plan. Soil pH shall be considered when determining the fertilization composition as soil pH influences the tree's ability to uptake nutrients from the soil. If analyses indicate the need for supplemental nutrients, then humate/nutrient solutions with mycorrhizae components are highly recommended. In addition, soil analysis may be needed to determine if

organic material or beneficial microorganisms are needed to improve soil health. Materials and methods are to be approved by the City Arborist (512-974-1876) prior to application. The owner or general contractor shall select a fertilization contractor and ensure coordination with the City Arborist.

Pre-construction treatment should be applied in the appropriate season; ideally the season preceding the proposed construction. Minimally, areas to be treated include the entire critical root zone of trees as depicted on the City approved plans. Treatment should include, but not limited to, fertilization, soil treatment, mulching, and proper pruning.

Post-construction treatment should occur during final revegetation or as determined by a qualified arborist after construction. Construction activities often result in a reduction in soil macro and micro pores and an increase in soil bulk density. To ameliorate the degraded soil conditions, aeration via water and/or air injected into the soil is needed or by other methods as approved by the City Arborist. The proposed nutrient mix specifications and soil and/or foliar analysis results need to be provided to and approved by the City Arborist prior to application (Fax # 512-974-3010). Construction which will be completed in less than 90 days may use materials at ½ recommended rates. Alternative organic fertilizer materials are acceptable when approved by the City Arborist. Within 7 days after fertilization is performed, the contractor shall provide documentation of the work performed to the City Arborist, Planning and Development Review Department, P.O. Box 1088, Austin, TX 78767. This note should be referenced as item #1 in the Sequence of Construction.

H. Oak Wilt Prevention Policy

1. Purpose and Scope

The purpose of this Oak Wilt Prevention Policy is to identify measures that city staff and city-hired contractors and their sub-contractors, who perform the services of removing or trimming trees, will take to prevent the spread of oak wilt.

2. Definitions

Oak Wilt Disease: A tree disease caused by the fungus, *Ceratocystis fagacearum*. The fungus infects the vascular system of a tree. The vascular system contains vessels which transport moisture throughout the tree. The vessels of an infected tree effectively become blocked by the infection of the fungus, and cannot transport adequate moisture to sustain a healthy or living tree. In most cases, the end result is tree mortality.

3. Prevention Policy

- (a) Prior to beginning field work, all city staff associated with projects involving potential contact with oak trees shall be made aware of the city's official Oak Wilt Policy by receiving and reading a written copy of this policy. Staff receiving a written copy of the policy shall include, but not limited to, project managers, equipment operators responsible for removing or trimming trees, or operators using heavy equipment which could cause wounding of susceptible oaks in the use of the equipment. In addition, individual city departments will provide a written copy of the Oak Wilt Policy to contractors participating in city projects in areas where oak trees are present before initiating field work.
- (b) When possible, city staff and contractors should avoid trimming, pruning, or wounding Live Oaks and Red Oaks (Spanish, Shumard, Texas Red, and Blackjack oaks) from February through June.
- (c) At all times and irrespective of limb size, all cuts and wounds to oak trees shall be dressed immediately using a non-phytotoxic tree wound dressing. Stump cuts and damaged roots (both above and below ground) shall also be dressed.
- (d) Disinfection of pruning tools, saws, and related equipment is mandatory during the trimming or pruning of oak trees. Disinfection of tree removal and trimming equipment shall occur before work begins in a project area, between work in individual oak trees, and again prior to leaving a

project area. Acceptable disinfectants include either aerosol disinfectant or a 10 percent bleach-water solution.

*NOTE: Although this policy would require the disinfection of pruning equipment before and between oak trees as a precaution, research does not substantiate disinfection as a means of preventing the transmission of the oak wilt disease.

4. Disposal Policy

- (a) Chipping or shredding the wood from infected trees to use as mulch is an acceptable means of recycling the wood. Chipping or shredding allows the wood to dry out quickly, thereby killing the fungus.
- (b) Burning diseased wood is an acceptable means of disposal. Burning diseased logs will kill the fungus, and the fungus will not spread with the smoke.
- (c) Logs from diseased Red Oaks, that are not chipped, shredded, or burned shall be disposed of at a landfill.
- (d) Firewood from diseased Red Oak trees shall not be stored near healthy trees where fungal spores or insects that carry the spores have the potential to spread the fungus to healthy trees. It is recommended to store oak firewood under a sheet of clear plastic, tightly sealing the edges of plastic with soil or bricks. Doing so will prevent any spore carrying beetles from escaping and will solarize and heat the stored firewood to speed the drying process. It is also recommended to use clear plastic, as black plastic will reveal any escape holes to the beetles.
- (e) In situations where diseased Red Oak trees are identified and are not accessible for chipping, shredding, or removal, the trunk of the diseased tree should be girdled, and the stem treated with an appropriate herbicide to deaden the tree and hasten the desiccation and drying of the wood below the minimum moisture content that could support the development of fungal spores.

610S.5 Measurement

Tree and shrub pruning, fencing, drains, fertilization, etc. will not be measured for payment unless included as a contract pay item. Tree wells for tree protection will be measured by the units, complete in place, conforming to the Drawings and City of Austin Standard Detail 610S-6, "Tree Protection, Tree Wells".

Removal of existing trees will be measured per each tree.

610S.6 Payment

The work and materials prescribed herein with the exception of the Protective Fencing and Tree Well (Tree Protection) will not be paid for directly but shall be included in the unit price bid for the item of construction in which this activity is used, unless a payment item is included as a contract pay item.

Payment will be made under:

Pay Item 610S-A:	Protective Fencing Type A Chain Link fence (Typical Application-high damage potential)	Per Lineal Foot
Pay Item 610S-B:	Protective Fencing Type B Wood Fence (Typical Application-high damage potential)	Per Lineal Foot
Pay Item 610S-C:	Protective Fencing Type C Other Materials (Limited Application-minimal damage potential)	Per Lineal Foot
Pay Item 610S-D:	Tree Well (Tree Protection)	Per Each

Pay Item 610S-E:	Tree Trunk Protection (Wood Planking)	Per Each
Pay Item 610S-R:	Removal of Existing Trees	Per Each

Source: Rule No. R161-18.24 , 12-7-2018.

End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Specification Item 610S, "Preservation of Trees and Other Vegetation"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 606S	Fertilizer
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
Item No. 610S-1	Tree Protection Fence Locations
Item No. 610S-2	Tree Protection Fence, Type A, Chainlink
Item No. 610S-3	Tree Protection Fence, Type B, Wood
Item No. 610S-4	Tree Protection Fence, Modified Type A, Chainlink
Item No. 610S-5	Tree Protection Fence, Modified Type B, Wood
Item No. 610S-6	Tree Protection, Tree Wells
<u>City of Austin Transportation Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 1.3.1.C.6	Sight Distance
Section 6.2.3.A.4	Clearance Height
Figure 1-6	Desirable Sight Triangle
<u>City of Austin Environmental Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Appendix P-2, Note 6	Exceptions to Installing Fences
Appendix P-2, Note 6c	Trees close to proposed buildings - - -
Appendix P-6	Remedial Tree Care Notes
Section 3.3.2.A.2	Diameter of trees - - -
Section 3.5.0	Design Criteria
Section 3.5.3.A.1	Permeable Paving
Figure 3-8	Example of Minimum Design Criteria Applied to Permeable Parking
<u>City of Austin Land Development Code</u>	
<u>Designation</u>	<u>Description</u>
Section 25-8-603	Tree Protection Administration
Section 25-8-623	Inspection by City Arborist
<u>ASTM, American Society for Testing and Materials</u>	
<u>Designation</u>	<u>Description</u>
D-2729	Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

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(Supp. No. 5-2021)

RELATED CROSS REFERENCE MATERIALS	
<u>Specification 610S, "Preservation of Trees and Other Vegetation"</u>	
<u>City of Austin Standard Specification Items</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right-of-way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 132S	Embankment
Item No. 608S	Planting
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 160	Furnishing and Placing Topsoil
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering

ITEM NO. 639S ROCK BERM 8-18-10

639S.1 Description

This item shall govern the construction of a temporary berm of open graded rock that is installed at the toe of a slope on the perimeter of a developing area. Rock berms are appropriate for use as flow diverters, energy dissipators, grade control, and level spreaders to release the water in sheet flow (Environmental Criteria Manual Section 1.4.5.E). This item shall also govern the removal of the "Rock Berm" and re-vegetation of the area.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

639S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Function (flow diversion, grade control, energy dissipator, level spreader, or other) and dimensions of the rock berm
- B. Source, type and gradation of rock
- C. Re-vegetation program, including:
 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
 2. Type of mulch.
 3. Type of tacking agent.
 4. Type and rate of application of fertilizer.

639S.3 Design Criteria

A detailed design is not required for the installation of a rock berm; however, the following criteria shall be observed:

Drainage area	-	less than 5 acres (2 hectares).
Height	-	18 inches (450 mm) minimum height, measured vertically from the top of the existing ground at the upslope toe to the top of the berm.
Top width	-	2 feet (0.6 meter) minimum.
Side slopes	-	2:1 or flatter.
Grade	-	Berms will be built along a contour as near possible to a 0 percent grade.

639S.4 Materials

Surplus rock excavated from utility trenches or from other excavations may be used in construction of these berms. In general, the rocks shall be sound with a minimum of 3 inches (75 mm) in smallest dimension and shall weigh between 10 and 30 pounds (4.5 to 13.6 kilograms) each. Seeding for re-vegetation shall conform to Item No. 604S, "Seeding for Erosion Control".

Use only open-graded rock of the size indicated on Standard Detail No. 639S-1, with most of the fines removed.

639S.5 Construction Methods

All trees, brush, stumps and objectionable material shall be removed and disposed in a manner that will not interfere with the construction of the berm.

A trench shall be excavated to a minimum depth of 4 inches (100 mm) below existing grade for placement of the rock as indicated on Standard Detail No. 639S-1 and the Drawings. The rocks shall be placed in interlocking layers with close joints starting at the base. Open joints shall be filled with rock-spalled materials as required to stabilize the berm.

The area upstream from the rock berm shall be maintained in a condition, which will allow sediment to be removed following the runoff from a rainfall event. After each rainfall event with an accumulation of 1 inch (25 mm) or more, an inspection of the rock berm will be made by the Contractor and the stone shall be replaced, when the structure ceases to function as intended because of sediment accumulation among the rocks, washout, construction traffic damage, etc.

If the sediment reaches a depth equal to $\frac{1}{3}$ the height of the berm or 6 inches (150 mm), whichever is less, the Contractor will remove the accumulated sediment and dispose of it at an approved disposal site in a manner that will not contribute to additional sedimentation. The berm will be reshaped as needed during construction.

When the site is completely stabilized, the berm will be removed and disposed of in a manner approved by the Engineer or designated representative.

The area will be re-vegetated as required by Item No. 604S, "Seeding for Erosion Control".

639S.6 Measurement

Acceptable work performed and prescribed in this item will be measured by the linear foot (lineal meter: 1 lineal meter equals 3.281 lineal feet) along the centerline of top of berm.

639S.7 Payment

The work performed and material furnished and measured as provided under "Measurement" to construct this item will be paid for at the unit bid price per linear foot of rock berm barrier as indicated on the Drawings. The Unit Bid Price shall include full compensation for: (a) furnishing, hauling and placing all materials including all labor, tools, equipment and incidentals needed to complete the work, (b) maintaining the berm, (c) removing sediment accumulations, (d) rock replacement, (e) removing and disposing of all materials when the berm is no longer required and (f) re-vegetating the site upon removal of the berm.

Payment will be made under:

Pay Item No. 639S:	Rock Berm	Per Lineal Foot.
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End

SPECIFIC CROSS REFERENCE MATERIALS	
<u>Specification 639S, "Rock Berm"</u>	
<u>City of Austin Environmental Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 1.4.2.E	Rock Berm

<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
Number 639S-1	Rock Berm
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 604S	Seeding for Erosion Control

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 639S, "Rock Berm"</u>	
<u>City of Austin Environmental Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Table 1-1.3	Recommended Design Values For Functional Controls
Table 1-2	Maximum Water Depth At The Barrier
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right-of-way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 602S	Sodding for Erosion Control
Item No. 605S	Soil Retention Blanket
Item No. 606S	Fertilizer
Item No. 608S	Planting
Item No. 610S	Preservation of Trees and Other Vegetation
Item No. 620S	Filter Fabric
<u>Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges</u>	
<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 166	Fertilizer
Item No. 168	Vegetative Watering
Item No. 169	Soil Retention Blanket
Item No. 204	Sprinkling

ITEM NO. 641S STABILIZED CONSTRUCTION ENTRANCE 6-21-07

641S.1 Description

This item governs the construction of a stabilized pad of crushed stone located at any point where traffic will be entering or leaving a construction site to or from a public right-of-way, street, alley, sidewalk or parking area. The removal of the stabilized pad of crushed stone shall also be included in the item. The purpose of a stabilized construction entrance is to reduce or eliminate the tracking or deposition of sediment onto public right-of-way (Environmental Criteria Manual Section 1.4.2.N.4).

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

641S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, type and gradation of rock.
- B. Drainage technique (i.e. drainage swale or entrance grading) proposed to prevent runoff from exiting the construction site.

641S.3 Materials

Aggregate for construction shall conform to the following gradation:

Table 1: Aggregate Gradation Chart (TEX 401-A, % Retained per sieve)		
US 8 inch (SI 200 mm)	US 5 inch (SI 125 mm)	US 2 inch (SI 50 mm)
0	90-100	100

641S.4 Construction Methods

All trees, brush, stumps, obstructions and other objectionable material shall be removed and disposed of in a manner that will not interfere with the excavation and construction of the entrance as indicated on the Drawings or as presented in Standard Details No. 641S-1. The entrance shall not drain onto the public right-of-way or shall not allow surface water runoff to exit the construction site.

When necessary, vehicle wheels shall be cleaned to remove sediment prior to entrance onto public right-of-way. When vehicle washing is required, it shall be done on an area stabilized with crushed stone, which drains into an approved sediment trap or sediment basin. All sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, boards, silt fence (Standard Specification Item No 642S) or other methods approved by the Engineer or designated representative.

The entrance shall be maintained in a condition that will prevent tracking or disposition of sediment onto public right-of-way. This restriction may require periodic top dressing with additional stone as conditions demand, as well as the repair and/or cleanout of any measures used to trap sediment. All sediment that is spilled, dropped, washed or tracked onto public right-of-way must be removed immediately.

641S.5 Measurement

Acceptable work performed as prescribed in this item will be measured by unit of each stabilized construction entrance installed.

641S.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per each "Stabilized Construction Entrance." The price shall include full compensation for furnishing, hauling and placing all materials, labor, tools, equipment and incidentals necessary to complete the work including inspecting, repairing, replacing and relocating existing fencing, removal of silt and removal and disposal of all materials at the completion of construction. The price shall include full compensation for furnishing, installing, maintaining, moving, and removing any traffic control devices required by the installation of a stabilized construction entrance.

Payment, when included as a contract pay item, will be made under:

Pay Item No. 641S:	Stabilized Construction Entrance	Per Each.
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Source: Rule No. R161-21.01 , 3-25-2021.

End

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
Specification 641S, "Stabilized Construction Entrance (SCE)"	
City of Austin Environmental Criteria Manual	
<u>Designation</u>	<u>Description</u>
Section 1.4.2.N.4	Stabilized Construction Entrance "Design Criteria"
City of Austin Standard Details	
<u>Designation</u>	<u>Description</u>
Number 641S-1	Stabilized Construction Entrance
City of Austin Standard Specifications	
<u>Designation</u>	<u>Description</u>
Item No. 642S	Silt Fence (SF)

<u>RELATED CROSS REFERENCE MATERIALS</u>	
Specification 641S, "Stabilized Construction Entrance (SCE)"	
City of Austin Environmental Criteria Manual	
<u>Designation</u>	<u>Description</u>
Section 1.4.2.J	Sandbag Berm
Figure 1-11	Sand Bag Berm
Section 1.4.2.G	Silt Fence
City of Austin Standard Specifications	

<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right-of-way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

<u>Designation</u>	<u>Description</u>
Item No. 100	Preparing Right-of-way
Item No. 110	Excavation
Item No. 132	Embankment
Item No. 158	Specialized Excavation Work
Item No. 168	Vegetative Watering

ITEM NO. 642S SILT FENCE 9-1-11

642S.1 Description

This item shall govern the provision and placement of a silt fence fabric fence (Environmental Criteria Manual Section 1.4.5.G) including maintenance of the fence, removal of accumulated silt, removal of the silt fence and re-vegetation of disturbed areas upon completion of the project.

This specification is applicable for projects or work involving either inch-pound or SI units. Within the text, the inch-pound units are given preference followed by SI units shown within parentheses.

642S.2 Submittals

The submittal requirements for this specification item shall include:

- A. Source, manufacturer, characteristics and test data for the silt fence fabric,
- B. Manufacturer, characteristics and test data for the posts and wire fence.
- C. Re-vegetation program, including:
 - 1. Identification of the type, source, mixture, Pure Live Seed (PLS) and rate of application of the seeding.
 - 2. Type of mulch.
 - 3. Type of tacking agent.
 - 4. Type and rate of application of fertilizer.

642S.3 Materials

- A. Fabric
 - 1. General:

The silt fence fabric shall be of nonwoven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The silt fence fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The silt fence fabric shall be supplied in rolls a minimum of 36 inches (0.9 meter) wide.
 - 2. Physical Requirements:

The fabric shall meet the requirements presented in Table 1, when sampled and tested in accordance with the methods indicated herein, on Standard Detail No. 642S-1 and/or on the Drawings.
- B. Posts:

Posts shall be steel Tee or Y-posts, not less than 4 feet (1.22 meters) in length with a minimum weight of 1.25 pounds per foot (1.86 kilograms per meter) with a minimum Brinell Hardness of 143. Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A-702. Caps are required (*not specifying discretionary criteria).
- C. Wire Fence:

Wire fence shall be welded wire fabric 2 in. x 4 in. 12.5 SWG, wire diameter 0.099 in (±0.005 in.), and shall conform to Standard Specification Item No. 406, "Reinforcing Steel".

TABLE 1. Silt Fence Fabric Requirements		
Physical Properties	Method	Requirements
Fabric Weight in ounces per square yard (grams/square meter)	TEX-616-J ¹	5.0 minimum (150 minimum)
Equivalent Sieve Opening Size: US Standard (SI Standard sieve size)	CW-02215 ²	40 to 100 (425 to 150 µm)
Mullen Burst Strength: lbs. per sq. inch (psi) megaPascal (mPa)	ASTM D-3786 ³	280 minimum (1.9 minimum)
Ultraviolet Resistance; % Strength Retention	ASTM D-1682 ⁴	70 minimum

¹ TxDOT Test Method Tex-616-J, "Testing of Construction Fabrics".

² US Army Corps of Engineers Civil Works Construction Guide Specification CW-02215, "Plastic Filter Fabric".

³ ASTM D-3786, " Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method".

⁴ ASTM D-1682, " Test Methods for Breaking Load and Elongation of Textile Fabrics ".

642S.4 Construction Methods

The silt fence fabric shall be securely attached to the posts and the wire support fence with the bottom 12 inches (300 mm) of the material buried in a trench a minimum of 6 inches (150 mm) deep and 6 inches (150 mm) wide to prevent sediment from passing under the fence. When the silt fence is constructed on impervious material, a 12-inch (300-mm) flap of fabric shall be extended upstream from the bottom of the silt fence and weighted to limit particulate loss. No horizontal joints will be allowed in the silt fence fabric. Vertical joints shall be overlapped a minimum of 12 inches (300 mm) with the ends sewn or otherwise securely tied.

The silt fence shall be a minimum of 24 inches (0.6 meter) high. Posts shall be embedded a minimum of 12 inches (300 mm) in the ground, placed a maximum of 8 feet (2.4 meters) apart and set on a slight angle toward the anticipated runoff source. When directed by the Engineer or designated representative, posts shall be set at specified intervals to support concentrated loads.

* Per OSHA §1926.701, "all protruding reinforcing steel, onto and into which employees could fall, shall be guarded to eliminate the hazard of impalement". Caps must be large enough to dissipate the forces of impact to prevent impalement from a reasonably foreseeable fall distance. It should be noted that the use of impalement protection caps is but one method of protection; covers or wooden troughs can be another means of meeting the guarding requirement. For City of Austin purposes, this also applies to t-posts and wooden stakes.

The silt fence shall be repaired, replaced, and/or relocated when necessary or as directed by the Engineer or designated representative. Accumulated silt shall be removed when it reaches a depth of 6 inches (150 mm).

642S.5 Measurement

The work performed and the materials furnished under this item will be measured by the lineal foot of "Silt Fence", complete in place.

642S.6 Payment

The work performed and materials furnished and measured as provided under "Measurement" will be paid for at the unit bid price per lineal foot of "Silt Fence". The price shall include full compensation for furnishing, hauling and placing all materials, labor, tools, equipment and incidentals necessary to complete the work including inspecting, repairing, replacing and relocating the fence, removal of silt and removal and disposal of all materials at the completion of construction in and re-vegetation of disturbed areas.

Payment will be made under:

Pay Item No. 642S:	Silt Fence for Erosion Control	Per Lineal Foot.
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END

<u>SPECIFIC CROSS REFERENCE MATERIALS</u>	
<u>Specification 642S, "Silt Fence"</u>	
<u>City of Austin Environmental Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Section 1.4.5.G	Silt Fence
<u>City of Austin Standard Details</u>	
<u>Designation</u>	<u>Description</u>
Number 642S-1	Silt Fence
<u>City of Austin Technical Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 406	Reinforcing Steel
<u>American Society For Testing and Materials (ASTM)</u>	
<u>Designation</u>	<u>Description</u>
A-702	Specification for Steel Fence Posts and Assemblies, Hot Wrought
D-1682	Test Methods for Breaking Load and Elongation of Textile Fabrics
D-3786	Test Method for Hydraulic Bursting Strength of Knitting Goods and Nonwoven Fabrics: Diaphragm Bursting Strength Tester Method
<u>Texas Department of Transportation Manual of Testing Procedures</u>	
<u>Designation</u>	<u>Description</u>
Tex-616-J	Testing of Construction Fabrics
<u>U.S. Army Corps of Engineers</u>	
<u>Designation</u>	<u>Description</u>
CW-02215	Civil Works Construction Guide Specification "Plastic Filter Fabric"

<u>RELATED CROSS REFERENCE MATERIALS</u>	
<u>Specification 642S, "Silt Fence"</u>	

<u>City of Austin Environmental Criteria Manual</u>	
<u>Designation</u>	<u>Description</u>
Table 1-1.3	Recommended Design Values For Functional Controls
Table 1-2	Maximum Water Depth At The Barrier
<u>City of Austin Standard Specifications</u>	
<u>Designation</u>	<u>Description</u>
Item No. 101S	Preparing Right-of-way
Item No. 102S	Clearing and Grubbing
Item No. 111S	Excavation
Item No. 120S	Channel Excavation
Item No. 401S	Structural Excavation and Backfill
Item No. 610S	Preservation of Trees and Other Vegetation

SPECIAL PROVISIONS TO CITY STANDARD TECHNICAL SPECIFICATIONS

These Special Provisions serve to modify, add to, and/or delete from City of Austin Standard Technical Specifications incorporated into this Project Manual as applicable to this project. Any item, paragraph, article of work contained therein, unless specifically modified, added to or deleted herein shall apply, where applicable.

MODIFICATION NOTES

1. Delete all "Measurement" and "Payment" Sections from all City of Austin Standard Technical Specifications, Special Provisions thereof, and Special Specifications required to perform the work, and replace with:

This item will not be measured for separate payment and the cost for this item shall be included in the Lump Sum Bid for the project.

2. Wherever a City of Austin Standard Specification refers to "City of Austin", delete and replace with "Central Health".

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SECTION 33 16 15 – STEEL WATER STORAGE TANKS

PART 1 GENERAL

- 1.01 SECTION INCLUDES
Water storage tanks
- 1.02 RELATED SECTIONS
Water supply piping, water use piping, electrical, irrigation, foundations, site plans.
- 1.03 REFERENCES
IBC, FDA , NSF-61
- 1.04 SUBMITTALS
Tank dimension drawings shall be submitted for approval prior to tank materials fabrication.
- 1.05 QUALIFICATION AND EXPERIENCE
Tank fabricator shall be experienced in manufacturing corrugated galvanized steel bolted tanks. Tank installer shall be experienced in the installation of tanks and working on commercial construction job sites. Tank installer shall be trained in confined space protocols (OSHA) and be able to prove a minimum of five (5) years of tank building experience.
- 1.06 DELIVERY, STORAGE AND HANDLING
Tank materials shall be shipped from factory on wood pallets designed to protect materials from normal shipping damage. Tank materials shall be stored to prevent the development of white rust onto galvanized steel.
- 1.07 WARRANTY
The manufacturer shall warrant the tank structure against defects in workmanship and materials for a period of thirty (30) years from the date of shipment of the materials from the factory. The manufacturer shall warrant the main liner against defects in workmanship and materials for a minimum of (10) ten years from the date of shipment of the materials from the factory on a pro-rata basis.

PART 2 PRODUCTS

- 2.01 WATER STORAGE TANK
The water storage tank shall be a CorGal Model **1503-WT-CHR** with standard 30 degree corrugated roof having a nominal capacity of **14,000** US gallons. Nominal tank dimensions shall be 15'-0" diameter, 10'-9" eave height, and 15'-2" overall height.
- A. General
The water storage tanks shall be standard factory engineered galvanized steel tanks with liquid tight liners. The water storage tanks shall be assembled and erected on site. The tank structure shall consist of corrugated, galvanized steel wall sheets, roof

panels, one roof panel with access hatch, standard peak cap, roof ladder angles, anchor clips and necessary hardware for tank assembly.

- B. Acceptable manufacturers
Water Storage Tanks, Inc. (www.waterstoragetanksinc.com; 800-463-1898)
- C. Bolted Tank Structure
Galvanized steel tank wall and roof panels shall be pre-punched at the factory for field assembly.
- D. Preliner
An 8 oz. black geotextile preliner shall be installed inside of the tank structure. The preliner shall cover the tank floor and the walls on all surfaces at which the main liner could contact the tank structure.
- E. Main Liner
Water containment system shall be a factory welded seam, flexible membrane main liner. The liners shall be installed inside of the water tank by the CorGal® method utilizing liner hanger bolts, seal washers and grommets for suspension.

2.02 TANK DESIGN CRITERIA

Water tank shall be designed to meet or exceed Seismic Zone 2B (Seismic Design Category

C) conditions, 90 MPH (UBC), 110 MPH (IBC) wind speed and 20 PSF roof live load. The tank structure shall be designed to contain potable or non-potable water having a density of 62.4 pounds per cubic foot.

2.03 STRUCTURAL MATERIALS

Water tanks shall be manufactured from high yield strength US steel (minimum of 57 ksi (393 MPa) yield strength for wall panels) originally sourced from a US steel mill and rolled/corrugated in a US plant.

Wall sheets shall be continuous 2-2/3" depth x 1/2" pitch (67.7 MM x 12.7 MM) annularly corrugated galvanized steel, 20 gauge steel or heavier with minimum yield strengths of 57,000 psi (3990 Kg/CM²) (Tensile strength 65,000+ psi [4550 Kg/CM²+]). All zinc coating shall conform to G-115 (275 grams/square meter) specifications or higher. Bottom wall sheets have an inward return flange for additional bearing on foundation. Wall sheets shall have a coverage length of 9' 4-1/2" (2,858 M) long, except for some 6' 3" (1,905 MM) long sheets used adjacent to the access door.

Holes in vertical seams shall be punched for single row or double row connections at 1-1/3" o.c (34 MM). Use of single row or double row of bolts at vertical seam is dependent upon diameter and depth of tank.

Horizontal seams shall have a single lap connection with a maximum bolt spacing to be 9-3/8" (238 MM).

One-piece, 12 gauge (2.67 MM) or heavier galvanized steel die-formed or welded anchor clips shall be supplied for a minimum of one anchor clip per base wall panel. Anchor clips shall be bolted to the tank wall with four bolts to contact a concrete base.

Water tank roofs shall have a 30° slope, and use single-stage self-supporting roof sheets. Roofs shall be designed for a 2 psf dead load, 20 psf live load, 20 psf snow load, and a peak equipment load rating of 2000 pounds (907 Kg). The tank shall be capable of being engineered for higher load ratings should the local conditions require it.

Roof sheets shall have triangular sections of galvanized steel, with brake-formed raised ribs along each side, flat area between ribs and a 90° formed drip edge at the eave.

Roof panels shall be manufactured from G-115 galvanized steel conforming to ASTM A 446, Grade C, or greater.

Roofs of 15' tanks (4.57 M) shall have 23 panels (22 straight panels, and 1 double wide with roof hatch). Panels shall have a formed box-type rib with a rib height of 3-1/4 inch (82 MM) rise above flat area.

All roof panels shall be connected to the eave of the tank with center clips and a varying number of rib clips depending on tank diameter. Holes in the top ring wall sheets shall be factory punched for clip installation. Press-on bulb type neoprene eave seal and silicone caulking shall be used to seal between the top wall panel and the roof panel.

Roof ladder cleats shall extend from eave to center cap. Ladder cleats shall consist of galvanized steel cold-formed angles of varying lengths bolted to top of one roof panel.

2.04 TANK ACCESS

A 22" round access hole with cover shall be at the top center of the roof. A 31" X 18" rectangular access hole with hinged cover shall be located on the lower end of one roof sheet. A 20" X 40" bolted side access panel shall be located 22" above the floor on a side panel. The side access shall be bolted closed before final installation of the main liner.

2.05 TANK PENETRATIONS

Tank penetrations through the floor of the tank or the tank wall within the water storage level shall be completed utilizing modified schedule 80 PVC flange sets. Flanges shall be bolted together with stainless steel or brass hex head cap screws with bonded sealing washers at all liquid side holes. Liquid seam sealant may be used to ensure effective sealing.

It is NOT acceptable to utilize flanges which use a single set of through-bolts which essentially "sandwich" the liner and flanges faces to the steel wall. This method may cause additional leak points and may compromise the structural integrity of the tank wall.

2.06 TANK FOUNDATION

The tank foundation shall be a concrete pad that will extend at least 9" outside of the tank wall in all directions. The foundation design and construction is not covered by this section of the specifications.

2.07 HARDWARE

All bolts and nuts shall be electro-galvanized with JS-1000 clear coat protective coating. Roof bolts shall have factory-installed steel-backed vinyl washers. Wall sheet bolts shall have slotted button heads for insertion from inside toward outside. All bolts shall be heat treated and meet SAE Grade 8.2 or stronger specifications.

2.08 FLEXIBLE MEMBRANE LINER

The flexible membrane liner shall have minimum a rated thickness of 24 mil (+/- 10%) and a minimum finished coated weight of 22.0 oz/yd² (+2/-1 oz/yd²). The liner shall be a PVC coated polyester fabric liner or polypropylene coated fabric reinforced liner. If the tank is intended for potable use, then the liner shall carry the NSF-61 certification. The liner shall be fabricated with a minimum of 1.5" factory welded seams and shall have a poly rope in the top hem for reinforcement. Metal or PVC grommets shall be evenly

spaced along the top hem to facilitate the CorGal® method of liner hanging.

2.09 ANCHOR CLIPS

The anchor clips and anchor bolts shall conform to the structural design calculation package, if provided, and shall always meet site-specific requirements to properly anchor the tank in accordance with seismic, wind load, and other environmental conditions. Anchor clips shall be placed no less than every 39" around the perimeter of the tank.

Where seismic anchors are not required, the base anchor shall be a pre-formed anchor clip made of 12 GA. hot dipped galvanized steel which conforms to the tank wall corrugations. The anchor clip shall have a 1" hole in the base to accommodate the specified anchor bolt. The anchor clip shall be secured to the wall of the tank with no fewer than four 3/8" bolts.

Where seismic anchors are not required, but wind loads or other environmental conditions exceed base tolerances, then a heavy duty anchor clip shall be used. The heavy duty anchor clip shall be made from 7 GA. hot dipped galvanized steel. The anchor clip shall have a 1" hole in the base to accommodate the specified anchor bolt. The anchor clip shall be secured to the wall of the tank with no fewer than four 3/8" bolts.

Where seismic anchor clips are required, an anchor "chair" shall be utilized with the anchor bolt extending through the base plate and through a 1" hole in the top plate of the chair. A minimum of 9 15/16" inches shall separate the two plates to allow for stretch of the anchor bolt during a seismic event. Additional spacing may be required for various duty of chairs. The anchor chair shall be secured to the wall of the tank with no fewer than six 3/8" bolts.

PART 3 EXECUTION

3.01 INSTALLATION

Tanks shall be and assembled by personnel trained and experienced in the erection of bolted steel tanks and the installation of flexible membrane liners so as to not void any manufacturer warranties. Installation personnel entering the tank must be trained on confined space OSHA protocols.

3.02 FIELD QUALITY CONTROL

A representative of the tank materials supplier shall inspect the tank structure before installation of the preliner and main liner. Tank assembly contractor shall comply with tank supplier recommendations for the proper assembly techniques.

3.03 CLEANING and MAINTENANCE

Water tanks are classified as confined spaces and qualified personnel should be employed for any tank entry. The preferred method for cleaning the tanks is to open the bottom drain valve and drain the tank. Then open the roof side cover and use a hand-held water hose to wash down the tank walls and floor toward the tank drain. After cleaning is complete, close and secure the roof access cover and close the bottom drain valve.

END OF SECTION 33 16 15



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Commissioning Plan: Central Health Del Valle Health and Wellness Center Cx

Gresham Smith Project #: 45205.00

8/15/2021





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Hornsby Bend Health and Wellness Center Cx – Commissioning
Narrative

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Introduction

This project consists of a new approximately 19,000 square feet, freestanding, health and wellness center building at 7050 Elroy Rd. Del Valle, Tx. 78617 It is undergoing the commissioning process according to the criteria described in the 2016 Austin Energy Green Building Commercial Rating Guidebook (AEGB 2016). The project team seeks to meet all conditions required to satisfy the following Prerequisite(s) and Credit(s):

- I. 2016 Austin Energy Green Building Commercial Rating Guidebook (AEGB 2016): Fundamental Commissioning and Verification
- II. 2016 Austin Energy Green Building Commercial Rating Guidebook (AEGB 2016): Enhanced Commissioning- Option 1

Commissioning Scope

Several design phase activities are required to be completed for the commissioning process (e.g. review of documents and ensuring commissioning requirements are included in the contract documents). These tasks and all design phase deliverables have been completed and are not outlined in this narrative. This narrative serves as a guide for all commissioning team members throughout the construction, acceptance, and warranty phases of the project. Remaining deliverables/tasks are outlined below:

- I. Fundamental Commissioning Scope of Work
 - A. Provide a commissioning kick-off meeting at the site directly before or after a normally scheduled OAC meeting.
 - B. Develop a project specific commissioning plan (this document). It is composed of the following:
 1. Table of Contents
 2. A project specific commissioning narrative
 3. A Commissioned Systems List detailing all commissioned systems
 4. Pre-functional Checklists(PFC's) to be completed by the contractor. GS&P will conduct one pre-functional site visit to back-check installations.
 5. Functional Performance Tests (FPT's): To be directed by GS&P with the cooperation of the Contractor.
 6. A sample Master Issues List.
 - II. Provide a construction phase site visit to perform contractor Pre-Functional Checklists.
 - III. Provide a construction phase site visit to perform final PFC backcheck and direct contractor in Functional Performance Testing.
 - IV. Maintain an issues log and benefits log through-out the Commissioning Process.

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- V. Document all findings at the conclusion of each site visit and provide a report directly to the owner and EOR.
- VI. Prepare a final commissioning process report at the conclusion of construction commissioning activities.
 - I. Enhanced Commissioning Scope of Work
 - A. Review the Contractors executed pre-functional checklist on site with the contractors per Commissioning Guideline requirements.
 - B. Perform the per-functional checklists per Commissioning Guidelines requirements. Sample rate to be 25 percent.
 - C. Provide the contractor in the execution of the functional performance tests and record the data for each test. The functional performance testing sample rate is 100 percent with this standard.
 - D. Provide a systems manual to the owner at the conclusion of the construction phase.
 - E. Verify operator and occupant training has been provided and is adequate.
 - F. Document all findings at the conclusion of each site visit and provide a report directly to the owner and EOR which contains the following: The executed functional performance tests. Itemization of deficiencies found during testing that have not yet been corrected at the time of report preparation. Deferred tests that can't be performed at the time of report preparation due to climatic conditions and a description of the climatic conditions necessary for the test.

The systems/equipment to be included in the commissioning tasks outlined above are listed below:

- I. Indoor Variable Refrigerant Flow Indoor units
- II. Dedicated Outside Air Systems
- III. Variable Refrigerant Flow Systems
- IV. Exhaust Fans
- V. Building Automation System
- VI. Utility Monitoring System
- VII. Power Distribution System
- VIII. Lighting Controls
- IX. Power Generation
- X. Domestic Water Heating System
- XI. Plumbing Systems
- XII. Irrigation System
- XIV. Sprinkle System
- XV. Fire Alarm System
- XVI. Renewable Energy Systems

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These systems are outlined more specifically in the Commissioned Systems List located further into this Commissioning Plan.

Commissioning Team Members

In order to satisfy the above outlined scope, the commissioning effort is led by the Owner's appointed Commissioning Authority (CxA) – Gresham Smith; however, for the project to be successfully commissioned, other members of the design and construction teams have responsibilities to fulfill during the commissioning process. These commissioning team members are listed below. Their roles and responsibilities are outlined subsequently within this document.

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Members Appointed by CxA/Owner:

- A. CxA Project Manager and CxA Field Personnel
- B. Owner's Architect and Engineering design team
- C. Owner's Project Manager or Representative
- D. Owner's facility maintenance staff

II. Members Appointed by the Contractors:

- A. Commissioning Coordinator: A person or entity employed by the Contractor to manage, schedule, and coordinate commissioning.
- B. Project superintendent and other employees that the Contractor may deem appropriate for a portion of the commissioning.
- C. Subcontractors, installers, suppliers, and specialists that the Contractor may deem appropriate for a portion of the commissioning. These team members, at a minimum consist, of the Mechanical contractor, the Controls contractor, the Test and Balance contractor, the Electrical contractor, the Plumbing Contractor, and any necessary vendor representatives associated with commissioned systems.

All appointed Commissioning Team members have the authority to act on behalf of the entity they represent.

Commissioning Kick-off Meeting

The CxA will work with the owner in determining the commissioning team members necessary to attend the commissioning kick-off meeting. This commissioning plan has been completed and has been made available to the commissioning team for review prior to the kick-off meeting. The kick-off meeting accomplishes the following goals:

- I. Introduction of all team members to the commissioning process for the project.
- II. Coordination of all roles and responsibilities of each commissioning team member.
- III. Establishment of commissioning communication protocol throughout the process.
- IV. Determination of additional members to the commissioning team.
- V. Verification that the commissioning schedule is accurate and has been incorporated into the construction schedule.
- VI. Provision of opportunity for members of the team to ask questions regarding the commissioning process.

Commissioning Roles and Responsibilities

Each team member's roles and responsibilities during construction phase commissioning are described below:

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I. Owner

- A. Participate in issue resolution when requested regarding issues found on the commissioning issues list.

II. Engineer of Record

- A. Provide up-to-date construction documents to CxA for review.
- B. Answer RFIs as outlined in project construction documents.
- C. Provide design input/direction as needed to items.

III. Contractors

- A. Complete all Pre-Functional Checklists (PFCs) developed by CxA the for the commissioned systems. Sampling strategies are unacceptable. Pre-Functional Checklists to be completed via CxA's commissioning portal – CxAlloy. CxAlloy is explained further into this document.
- B. Attend commissioning meetings.
- C. Coordinate commissioning activities into construction schedule.
- D. Provide CxA with preliminary "pencil" Test, Adjusting, and Balancing (TAB) report for review.
- E. Perform all Functional Performance Tests (FPTs) at the direction of the CxA.
- F. Participate in any necessary seasonal testing determined by the CxA.
- G. Participate in Warranty Review meeting hosted by the CxA at a time deemed appropriated by the CxA to address any warranty issues before warranty expiration.

IV. Commissioning Authority

- A. See Commissioning scope of work provided in Introduction.

Cx Alloy

Cx Alloy is a cloud-based database that will be utilized to complete and track the PFCs, FPTs, and issues for this project. Gresham Smith will provide the necessary training to ensure required parties are familiar with Cx Alloy and understand how to complete PFCs and FPTs, review and correct issues, and upload all required documentation to this project. We encourage the Contractor to utilize iPad(s) and/or iPhone(s) to execute the FPCs for each piece of equipment, as the platform works best on these devices. The application is free for download on the Apple Store and is free for the commissioning team on this project.

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We ask that a *Commissioning Coordinator* be provided for each related trade who assumes responsibilities for executing the PFCs for each trade. A full listing of roles/personnel to participate in commissioning via CxAlloy is listed below:

- I. Required
 - A. General Contractor
 - B. Mechanical Contractor
 - C. Electrical Contractor
 - D. Controls Contractor
 - E. Plumbing Contractor

- II. Requested
 - A. Owner's Representative
 - B. Engineer of Record (EOR)
 - C. TAB Contractor

For each user required to have login, we request the following is provided to the PM via email.

- I. Company
- II. Role
- III. Name
- IV. Email

In addition to any training provided by Gresham Smith, there are also training videos that are provided at the following website:

- I. <https://support.cxalloy.com/collection/1-cxalloy-tq>

Deliverables

Commissioning deliverables will be provided to the Owner via PDF (except LEED Online verification). Upon request, PFCs, FPTs, and the Issues List can be provided in Excel form; however, we advise that the project team become familiar with responding to issues through the CxAlloy platform. The following deliverables will be provided to the owner throughout the construction phase commissioning process:

- I. A finalized Commissioning Plan.
- II. Conduct a design review of the documents with backcheck of the next drawing set to ensure compliance.

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- III. Kick-off meeting follow-up: A recap of any decisions made in the kick-off meeting regarding team members, coordination, and scheduling.
- IV. A PFC-Backcheck report with attached Issues List at the conclusion of the PFC backcheck site visit.
- V. A Functional Performance Testing report with attached Issues list after Functional Performance Testing.
- VI. Final Commissioning Report.
- VII. A review of adequacy of O&M documentation and Owner's training provided by contractors.
- VIII. A system manual.
- IX. One opposed seasonal test with site visit
- X. Re-commissioning services through the warrant period. Constrained to two sessions 7hrs each remotely with the BAS system of the facility.
- XI. On-going commissioning plan.

Contact Information

Any questions regarding this narrative or other portions of the Commissioning Plan can be directed to Gresham Smith's Commissioning Authority for this project with contact information shown below.

Justin Hethcote, P.E., CxA, LEED AP BD+C

Senior Project Manager

GRESHAM SMITH

Architecture, Engineering, Interiors, Planning

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Equipment

168 Equipment sorted by name



Gresham Smith

Gresham Smith | Central Health: Del Valle | 45205.00

Admin Office 309 - Ceiling Vacancy


Gresham Smith | Central Health: Del Valle | 45205.00

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Admin Office 309 - Ceiling Vacancy	20	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Admin Office 309 - Ceiling Vacancy	109	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Admin Office 310 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Admin Office 310 - Ceiling Vacancy	21	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Admin Office 310 - Ceiling Vacancy	110	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type Electrical Transfer Switch

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
ATS	158	NOT STARTED	<div style="width: 100%; height: 10px; background-color: #ccc; border: 1px solid #ccc;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1

BMS Utility Meters

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Utility Meter

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
BMS Utility Meters	1	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
BMS Utility Meters	2	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Breakdown/Receiving 231 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Breakdown/Receiving 231 - Ceiling Vacancy	22	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Breakdown/Receiving 231 - Ceiling Vacancy	111	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

BreakRoom 232 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
BreakRoom 232 - Ceiling Vacancy	23	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
BreakRoom 232 - Ceiling Vacancy	112	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Cambra 195 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Cambra 195 - Ceiling Vacancy	24	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Cambra 195 - Ceiling Vacancy	113	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Clean Work 226 - Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Clean Work 226 - Wall Vacancy	125	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Clean Work 226 - Wall Vacancy	114	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

CLIA 221 - Ceiling Vacancy

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Gresham Smith

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
CLIA 221 - Ceiling Vacancy	25	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
CLIA 221 - Ceiling Vacancy	115	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Collaboration 200 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Collaboration 200 - Ceiling Occupancy	2	NOT STARTED	0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Collaboration 200 - Ceiling Occupancy	83	NOT STARTED	0% Yes 0% No 0% N/A	0 ISSUES		1

Collaboration Space 403 - Ceiling Occupancy



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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
 Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Collaboration Space 403 - Ceiling Occupancy	3	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Collaboration Space 403 - Ceiling Occupancy	84	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Conference 300 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Conference 300 - Ceiling Vacancy	26	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Conference 300 - Ceiling Vacancy	116	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Conference 300 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Conference 300 - Dimmer Switch	138	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Conference 300 - Dimmer Switch	65	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Corridor 105 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Corridor 105 - Ceiling Occupancy	4	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Corridor 105 - Ceiling Occupancy	85	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Corridor 209 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Corridor 209 - Ceiling Occupancy	5	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Corridor 209 - Ceiling Occupancy	86	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Corridor 218 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Corridor 218 - Ceiling Occupancy	6	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Corridor 218 - Ceiling Occupancy	87	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Corridor 227 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Corridor 227 - Ceiling Occupancy	7	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Corridor 227 - Ceiling Occupancy	88	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Corridor 230 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Corridor 230 - Ceiling Occupancy	8	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Corridor 230 - Ceiling Occupancy	89	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Corridor 315 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Corridor 315 - Ceiling Occupancy	9	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Corridor 315 - Ceiling Occupancy	90	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Corridor 404 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Corridor 404 - Ceiling Occupancy	10	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Corridor 404 - Ceiling Occupancy	91	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Corridor 424 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Corridor 424 - Ceiling Occupancy	11	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Corridor 424 - Ceiling Occupancy	92	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Circulating Pump

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
CP	51	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
CP	3	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

DOAS-1

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type DOAS

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
DOAS-1	64	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
DOAS-1	4	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type DOAS

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
DOAS-2	65	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
DOAS-2	5	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Exhaust Fan

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
EF-1	55	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
EF-1	6	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Exhaust Fan

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
EF-2	56	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
EF-2	7	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Exhaust Fan

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
EF-3	57	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
EF-3	8	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Exhaust Fan

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
EF-4	58	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
EF-4	9	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

EF-ISO-1

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Exhaust Fan

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
EF-ISO-1	165	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
EF-ISO-1	10	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Exhaust Fan

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
EF-ISO-2	166	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
EF-ISO-2	11	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Equipment Storage 229 - Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Equipment Storage 229 - Wall Vacancy	126	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Equipment Storage 229 - Wall Vacancy	117	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 1 201 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 1 201 - Ceiling Vacancy	27	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 1 201 - Ceiling Vacancy	118	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Exam 1 201 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 1 201 - Dimmer Switch	139	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 1 201 - Dimmer Switch	66	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 2 202 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 2 202 - Ceiling Vacancy	28	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 2 202 - Ceiling Vacancy	119	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 2 202 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 2 202 - Dimmer Switch	140	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 2 202 - Dimmer Switch	67	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 3 203 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 3 203 - Ceiling Vacancy	29	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 3 203 - Ceiling Vacancy	120	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Exam 3 203 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 3 203 - Dimmer Switch	141	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 3 203 - Dimmer Switch	68	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 4 204 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 4 204 - Ceiling Vacancy	30	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 4 204 - Ceiling Vacancy	121	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Exam 4 204 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 4 204 - Dimmer Switch	142	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 4 204 - Dimmer Switch	69	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 5 205 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 5 205 - Ceiling Vacancy	31	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 5 205 - Ceiling Vacancy	122	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 5 205 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 5 205 - Dimmer Switch	143	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 5 205 - Dimmer Switch	70	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 6 206 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 6 206 - Ceiling Vacancy	32	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 6 206 - Ceiling Vacancy	123	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Exam 6 206 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 6 206 - Dimmer Switch	144	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 6 206 - Dimmer Switch	71	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 7 212 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 7 212 - Ceiling Vacancy	33	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 7 212 - Ceiling Vacancy	124	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exam 7 212 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exam 7 212 - Dimmer Switch	145	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exam 7 212 - Dimmer Switch	72	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Exterior Lighting

Gresham Smith | Central Health: Del Valle | 45205.00



Gresham Smith

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Exterior Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Exterior Lighting	59	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Exterior Lighting	12	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-1	68	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-1	16	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-2	69	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-2	17	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 1-3

Gresham Smith | Central Health: Del Valle | 45205.00



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-3	99	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-3	18	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-4	70	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-4	19	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 1-5

Gresham Smith | Central Health: Del Valle | 45205.00



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-5	100	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-5	20	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-6	101	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-6	21	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-7	71	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-7	22	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 1-8

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-8	72	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-8	23	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-9	102	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-9	24	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 1-10

Gresham Smith | Central Health: Del Valle | 45205.00



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-10	103	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-10	25	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-11	73	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-11	26	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-12	104	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-12	27	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-13	74	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-13	28	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-14	75	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-14	29	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 1-15

Gresham Smith | Central Health: Del Valle | 45205.00



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-15	76	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-15	30	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Wall Mounted

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 1-16	111	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 1-16	31	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-1	77	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-1	32	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-2	78	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-2	33	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-3	79	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-3	34	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-4	80	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-4	35	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-5	81	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-5	36	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-6	82	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-6	37	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-7	83	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-7	38	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-8	84	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-8	39	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-9	105	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-9	40	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-10	106	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-10	41	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-11A	107	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-11A	42	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 2-11B

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-11B	108	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-11B	43	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-12	85	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-12	44	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-13	86	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-13	45	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-14	87	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-14	46	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 2-15

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 2-15	88	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 2-15	47	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 3-1A

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-1A	89	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-1A	48	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-1B	90	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-1B	49	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-2	109	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-2	50	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-3	91	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-3	51	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-4	92	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-4	52	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-5	93	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-5	53	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-6	94	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-6	54	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-7	95	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-7	55	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-8	96	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-8	56	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Ducted Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-9	110	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-9	57	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 3-10

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Gresham Smith

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Wall Mounted

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-10	112	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-10	58	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Wall Mounted

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-11	113	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-11	59	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Wall Mounted

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-12	114	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-12	60	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Wall Mounted

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-13	115	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-13	61	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-14	97	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-14	62	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

FCU 3-15

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Cassette Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
FCU 3-15	98	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
FCU 3-15	63	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Financial Office 311 - Ceiling Vacancy

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Gresham Smith

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Financial Office 311 - Ceiling Vacancy	34	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Financial Office 311 - Ceiling Vacancy	125	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Financial Screen 312 - Ceiling Vacancy


Gresham Smith | Central Health: Del Valle | 45205.00

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Financial Screen 312 - Ceiling Vacancy	35	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Financial Screen 312 - Ceiling Vacancy	126	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Fire Alarm System

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Gresham Smith

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Fire Alarm System

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Fire Alarm System	60	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Fire Alarm System	13	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Fire Protection System

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EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type ▾ Fire Protection System

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Fire Protection System	61	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Fire Riser 307 - Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Fire Riser 307 - Wall Vacancy	127	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Fire Riser 307 - Wall Vacancy	127	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Flex 1 213 - Ceiling Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Flex 1 213 - Ceiling Vacancy	36	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Flex 1 213 - Ceiling Vacancy	128	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Flex 1 213 - Dimmer Switch

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Flex 1 213 - Dimmer Switch	146	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Flex 1 213 - Dimmer Switch	73	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Flex 2 214 - Ceiling Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Flex 2 214 - Ceiling Vacancy	37	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Flex 2 214 - Ceiling Vacancy	129	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Flex 2 214 - Dimmer Switch

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Flex 2 214 - Dimmer Switch	147	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Flex 2 214 - Dimmer Switch	74	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Flex 3 215 - Ceiling Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Flex 3 215 - Ceiling Vacancy	38	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Flex 3 215 - Ceiling Vacancy	130	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Flex 3 215 - Dimmer Switch

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Flex 3 215 - Dimmer Switch	148	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Flex 3 215 - Dimmer Switch	75	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Generator

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EQUIPMENT NOT ON SITE

1 CHECKLIST

3 TESTS

0 ISSUES

Type Electrical Generator

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Generator	157	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 3

Name	#	Status	Progress	Issues	Assigned To	Attempts
Generator - Load Bank	154	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1
Generator-Black site	152	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1
Generator-FPT	153	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type Natural Gas Water Heater

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
GWH	62	NOT STARTED	<div style="width: 0%;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1



EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
H1A	163	NOT STARTED	<div style="background-color: #ccc; width: 100%; height: 10px;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1



EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
H1B	164	NOT STARTED	<div style="width: 0%;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1



EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type VRF Domestic Water
Heater

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
HK-1	116	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
HK-1	64	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

HSKP 302 - Wall Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
HSKP 302 - Wall Vacancy	128	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
HSKP 302 - Wall Vacancy	131	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

HWWS Station 415 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
HWWS Station 415 - Ceiling Occupancy	12	NOT STARTED	0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
HWWS Station 415 - Ceiling Occupancy	93	NOT STARTED	0% Yes 0% No 0% N/A	0 ISSUES		1

Info 101 - Daylight

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Gresham Smith

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Daylight Sensor

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Info 101 - Daylight	156	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Info 101 - Daylight	1	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Irrigation System

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type ▾ Irrigation System

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Irrigation System	63	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Irrigation System	14	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type Electrical Panel

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
L1A	160	NOT STARTED	<div style="width: 0%;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1



EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
L1B	161	NOT STARTED	<div style="background-color: #ccc; width: 100%; height: 10px;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1



EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type Electrical Panel

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
L1C	162	NOT STARTED	<div style="width: 0%;"><div style="background-color: #ccc; height: 10px; width: 100%;"></div></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1

Lab 104 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Lab 104 - Ceiling Occupancy	13	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px; margin-bottom: 2px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Lab 104 - Ceiling Occupancy	94	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px; margin-bottom: 2px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Lab 423 - Occupancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Occupancy Sensor-
 Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Lab 423 - Occupancy	117	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Lab 423 - Occupancy	95	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

MDF/Security 303 - Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
MDF/Security 303 - Wall Vacancy	129	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
MDF/Security 303 - Wall Vacancy	132	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1



EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type Electrical Panel

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
MDP	159	NOT STARTED	<div style="width: 0%;"><div style="background-color: #ccc; height: 10px; width: 100%;"></div></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1

Med Gas 305 - Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Med Gas 305 - Wall Vacancy	130	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Med Gas 305 - Wall Vacancy	133	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Mens 107 - Ceiling Occupancy


Gresham Smith | Central Health: Del Valle | 45205.00

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Mens 107 - Ceiling Occupancy	14	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Mens 107 - Ceiling Occupancy	96	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Mens 107 - Occupancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Occupancy Sensor-
 Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Mens 107 - Occupancy	118	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Mens 107 - Occupancy	97	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Mothers Rm 313 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Mothers Rm 313 - Ceiling Vacancy	39	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Mothers Rm 313 - Ceiling Vacancy	134	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Mothers Rm 313 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Mothers Rm 313 - Dimmer Switch	149	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Mothers Rm 313 - Dimmer Switch	76	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

MS-1A

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Dedicated Split

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
MS-1A	67	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
MS-1A	15	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Multi-Function 110 Left - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Multi-Function 110 Left - Ceiling Vacancy	40	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Multi-Function 110 Left - Ceiling Vacancy	135	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1



Multi-Function 110 Right - Ceiling Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Multi-Function 110 Right - Ceiling Vacancy	41	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Multi-Function 110 Right - Ceiling Vacancy	136	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

ODU-1

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EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type VRF Outdoor Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
ODU-1	52	NOT STARTED	<div style="width: 0%;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1

ODU-2

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EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type ▾ VRF Outdoor Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
ODU-2	53	NOT STARTED	<div style="width: 0%;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1

ODU-3

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EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type ▾ VRF Outdoor Unit

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
ODU-3	54	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Panorex 405 - Wall Vacancy

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Gresham Smith

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Panorex 405 - Wall Vacancy	131	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Panorex 405 - Wall Vacancy	137	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Pat Toilet 419 - Occupancy

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Gresham Smith

EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Pat Toilet 419 - Occupancy	119	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Pat Toilet 419 - Occupancy	98	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Ped 1 216 - Ceiling Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Ped 1 216 - Ceiling Vacancy	42	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Ped 1 216 - Ceiling Vacancy	138	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Ped 1 216 - Dimmer Switch

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Ped 1 216 - Dimmer Switch	150	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Ped 1 216 - Dimmer Switch	77	NOT STARTED	<div style="width: 0%; background-color: #ccc; border-radius: 5px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Ped 2 217 - Ceiling Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Ped 2 217 - Ceiling Vacancy	43	NOT STARTED	<div style="width: 0%; background-color: #ccc; border: 1px solid #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Ped 2 217 - Ceiling Vacancy	139	NOT STARTED	<div style="width: 0%; background-color: #ccc; border: 1px solid #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Ped 2 217 - Dimmer Switch

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Ped 2 217 - Dimmer Switch	151	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Ped 2 217 - Dimmer Switch	78	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Pharmacy 500 - Switched

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EQUIPMENT NOT ON SITE

0 CHECKLISTS

0 TESTS

0 ISSUES

Type ▾ Wall Switch

Plumbing System - Misc

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EQUIPMENT NOT ON SITE

1 CHECKLIST

0 TESTS

0 ISSUES

Type ▾ Plumbing System

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Plumbing System - Misc	66	NOT STARTED	<div style="width: 0%;"></div> <p>0% Yes 0% No 0% N/A</p>	0 ISSUES	1

Procedure 207 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Procedure 207 - Ceiling Vacancy	44	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Procedure 207 - Ceiling Vacancy	140	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Procedure 207 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Procedure 207 - Dimmer Switch	152	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Procedure 207 - Dimmer Switch	79	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

PVT Adult 407 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
PVT Adult 407 - Dimmer Switch	153	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
PVT Adult 407 - Dimmer Switch	80	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

PVT Adult 408 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
PVT Adult 408 - Dimmer Switch	154	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
PVT Adult 408 - Dimmer Switch	81	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1



Room pressure Monitor - PVT Adult 408


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EQUIPMENT NOT ON SITE

0 CHECKLISTS

0 TESTS

0 ISSUES

Type  Room Pressure Monitor
--



Room pressure Monitor - Speciality Exam 208


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EQUIPMENT NOT ON SITE

0 CHECKLISTS

0 TESTS

0 ISSUES

Type  Room Pressure Monitor

Soiled Holding 228 - Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Soiled Holding 228 - Wall Vacancy	132	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Soiled Holding 228 - Wall Vacancy	141	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Spec Tlt 222 - Occupancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Spec Tlt 222 - Occupancy	120	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Spec Tlt 222 - Occupancy	99	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Speciality Exam 208 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Speciality Exam 208 - Ceiling Vacancy	45	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Speciality Exam 208 - Ceiling Vacancy	142	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Speciality Exam 208 - Dimmer Switch


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Dimmer Switch- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Speciality Exam 208 - Dimmer Switch	155	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Speciality Exam 208 - Dimmer Switch	82	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Staff Tlt 233 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Staff Tlt 233 - Ceiling Occupancy	15	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Staff Tlt 233 - Ceiling Occupancy	100	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Staff Tlt 233 - Occupancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Staff Tlt 233 - Occupancy	121	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Staff Tlt 233 - Occupancy	101	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Staff Toilet 422 - Occupancy



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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
 Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Staff Toilet 422 - Occupancy	122	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Staff Toilet 422 - Occupancy	102	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Staff Toilet 501 - Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Staff Toilet 501 - Occupancy	123	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Staff Toilet 501 - Occupancy	103	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Sterilization 421 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Sterilization 421 - Ceiling Vacancy	46	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Sterilization 421 - Ceiling Vacancy	143	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Storage 111 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Storage 111 - Ceiling Vacancy	47	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Storage 111 - Ceiling Vacancy	144	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Storage 224 - Ceiling Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Storage 224 - Ceiling Vacancy	48	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Storage 224 - Ceiling Vacancy	145	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Storage 406 - Wall Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Storage 406 - Wall Vacancy	133	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Storage 406 - Wall Vacancy	146	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Touchdown 1 220 - Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Touchdown 1 220 - Wall Vacancy	134	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Touchdown 1 220 - Wall Vacancy	147	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Touchdown 4 401 - Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Touchdown 4 401 - Wall Vacancy	135	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Touchdown 4 401 - Wall Vacancy	148	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Touchdown 5 402- Wall Vacancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Touchdown 5 402- Wall Vacancy	136	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Touchdown 5 402- Wall Vacancy	149	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

VAC 306 - Wall Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
VAC 306 - Wall Vacancy	137	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
VAC 306 - Wall Vacancy	150	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Vaccine 219 - Ceiling Occupancy

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EQUIPMENT NOT ON SITE

2 CHECKLISTS

1 TEST

0 ISSUES

Type Occupancy Sensor-
Lighting

Checklists 2

Name & Type	#	Status	Progress	Issues	Sections
Vaccine 219 - Ceiling Occupancy	16	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1
Vaccine 219 - Ceiling Occupancy	49	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Vaccine 219 - Ceiling Occupancy	104	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0% Yes 0% No 0% N/A</div>	0 ISSUES		1

Vestibule 100 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Vestibule 100 - Ceiling Occupancy	17	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Vestibule 100 - Ceiling Occupancy	105	NOT STARTED	<div style="width: 0%; background-color: #ccc;">0%</div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Vitals 223 - Ceiling Vacancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type Vacancy Sensor- Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Vitals 223 - Ceiling Vacancy	50	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Vitals 223 - Ceiling Vacancy	151	NOT STARTED	<div style="width: 0%;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Waiting 102 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Waiting 102 - Ceiling Occupancy	18	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Waiting 102 - Ceiling Occupancy	106	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Womens 106 - Ceiling Occupancy


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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Womens 106 - Ceiling Occupancy	19	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Womens 106 - Ceiling Occupancy	107	NOT STARTED	<div style="width: 0%; background-color: #ccc; height: 10px;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Womens 106 - Occupancy

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EQUIPMENT NOT ON SITE

1 CHECKLIST

1 TEST

0 ISSUES

Type  Occupancy Sensor-
Lighting

Checklists 1

Name & Type	#	Status	Progress	Issues	Sections
Womens 106 - Occupancy	124	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES	1

Tests 1

Name	#	Status	Progress	Issues	Assigned To	Attempts
Womens 106 - Occupancy	108	NOT STARTED	<div style="width: 0%; background-color: #ccc;"></div> 0% Yes 0% No 0% N/A	0 ISSUES		1

Checklists

166 Checklists sorted by name





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#20 Admin Office 309 - Ceiling Vacancy

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NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Admin Office 309 - Ceiling
 Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#21 Admin Office 310 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Admin Office 310 - Ceiling
 Vacancy


Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  ATS**Sections 1****First Section** NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION AND VERIFICATION

- 1 Take a picture of manufacturer tag and ID. Capture all available information as possible in images.

INSTALLATION

- 2 Bypass/ Isolation switch is installed
- 3 Equipment interiors are complete and clean
- 4 Equipment is secured to concrete housekeeping pad
- 5 Working Clearance: Per NEC 110.26
- 6 Switch provided with test switch to simulate failure of normal source
- 7 Switch provided with pilot lights to indicate normal and emergency position of switch
- 8 Switch provided with pilot lights to indicate availability of normal and emergency sources
- 9 Switch provided with terminal blocks labeling all external connections
- 10 Transfer switch provided with transfer override switch to cause switch to remain connected to emergency source regardless of condition of normal source
- 11 transfer switch provided with a retransfer switch to bypass retransfer time delay
- 12 Remote annunciation is provided and wired to the transfer switch (annunciator panel, BAS)

INSTRUMENTATION

- 13 Specified metering requirements
- 14 Verify metering provided as specified
- 15 Display and control unit are mounted flush or semiflush in instrument compartment door

IDENTIFICATION

- 16 Specified material and items to be included on label
- 17 Specified color coding
- 18 Verify label installed as specified
- 19 Bypass/ Isolation operating instructions are provided on the front of the unit
- 20 Specified additional labeling requirements
- 21 Verify additional labeling is complete

22 Specified conductor color coding

23 Verify conductors are properly color coded

#1 BMS Utility Meters

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset BMS Utility Meters

Sections 1

First Section **NOT STARTED**



Status set by Justin Hethcote on 8/15/2021.

- 1 Attach images of all unit tag data.
- 2 Installation
- 3 Natural Gas meter installed on main Natural Gas feed
- 4 Natural gas meter is pulse type meter-Record pulse to consumption equivalent
- 5 Verify that wiring pair is pulled to meter and not IP cabling
- 6 Domestic water meter installed on main Natural Gas feed
- 7 Domestic water meter is pulse type meter-Record pulse to consumption equivalent
- 8 Verify that wiring pair is pulled to meter and not IP cabling
- 9 Main facility electric meter installed on main Natural Gas feed
- 10 Main facility electric meter is pulse type meter-Record pulse to consumption equivalent
- 11 Verify that correct wiring is pulled to electric meter and terminated

#22 Breakdown/Receiving 231 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Breakdown/Receiving 231
 - Ceiling Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#23 BreakRoom 232 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  BreakRoom 232 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#24 Cambra 195 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Cambra 195 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#125 Clean Work 226 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Clean Work 226 - Wall
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL VACANCY



- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#25 CLIA 221 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  CLIA 221 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#2 Collaboration 200 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Collaboration 200 - Ceiling
 Occupancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#3 Collaboration Space 403 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Collaboration Space 403 -
 Ceiling Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#26 Conference 300 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Conference 300 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#138 Conference 300 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Conference 300 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer control installed on wall

#4 Corridor 105 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 105 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#5 Corridor 209 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 209 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#6 Corridor 218 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 218 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

CEILING OCCUPANCY



- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#7 Corridor 227 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 227 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#8 Corridor 230 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 230 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#9 Corridor 315 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 315 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#10 Corridor 404 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 404 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

CEILING OCCUPANCY



- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#11 Corridor 424 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 424 - Ceiling
 Occupancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  CP**Sections 1****First Section** NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Attach images of all unit tag data.

INSTALLATION

- 2 Unit is installed in accordance with detail 2 - P7.2: The following are included: Aquastat, Return temperature gauge, Shutoff valves on each side, unions on each side of pump, strainer on inlet, check valve on outlet)
- 3 Equipment is installed to facilitate service, maintenance, and repair or replacement of components.
- 4 Unit and piping are supported independently.
- 5 Unit is clean and installed in as-new condition. (Standard)

CONTROLS


- 6 Unit power disconnects are in place and labeled. (Standard)
- 7 All power connections are tight and snug. (Standard)
- 8 Proper grounding is installed for components and unit. (Standard)
- 9 All control wiring is completed. (Standard)
- 10 DDC connections to building controls wiring terminated to pump

INSULATION

- 11 Piping properly insulated with continuous vapor barrier (also fittings, and instrument connections for thermometers and pressure gauges).

LABELING

- 12 Permanent labels are installed on all equipment. Labels are installed in accessible and visible locations.
- 13 Pipe labels are located where piping is exposed or above ceilings and a maximum of 20' spacing between labels. Arrows are used to indicate direction of flow.
- 14 Tags are installed on piping valves and control devices.

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  DOAS-1**Sections 1****First Section** NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Attach image of all unit identification.
- 2 Unit is installed in accordance per design details
- 3 Unit inlet and outlet connections are made with flexible duct.
- 4 Equipment is installed to facilitate service, maintenance, and repair or replacement of components.
- 5 Equipment, piping and valves are supported independently.
- 6 Duct pressure sensor tubing terminated in duct
- 7 Operators, sensors, and control devices are installed to facilitate service, maintenance, and repair or replacement of components.
- 8 Unit is mounted on factory built roof mounting curb.- with vibration isolation
- 9 Curb filled with 6" of insulating sound batt per detail
- 10 Divider in place and sealed between the supply and return.
- 11 P-traps are installed for all drain pans.
- 12 Any bent fins have been repaired by combing coils.
- 13 Unit is clean and installed in as-new condition. (Standard)
- 14 Unit power disconnects are in place and labeled. (Standard)
- 15 All power connections are tight and snug. (Standard)
- 16 Proper grounding is installed for components and unit. (Standard)

FILTER

- 17 Filters are installed and clean. (Standard) - MERV-13 prefilters - 2"
- 18 No air gaps are visible around filters. (Standard)
- 19 Clearance provided for removal of filters. (Standard)
- 20 Spare set of filters provided (23 81 10-1.12)

SUPPLY FAN(S)

- 21 Clearance is provided for service and removal of fan motors. (Standard)

DX COIL

- 22 Condensate drain is routed per attached detail. (M4.1)
- 23 Unit provided with stainless steel or plastic drain pan.
- 24 Drain pan appears to be free of debris and is draining properly (Standard)
- 25 Drain pan high limit switch provided and wired for unit shut down.
- 26 Hail guard provided in DX coil
- 27 No visible growth or accumulation on coil or in drain pan(s). (Standard)

ELECTRICAL AND CONTROLS

- 28 Unit power disconnects are in place and labeled. (Standard)
- 29 Convenience outlet provided on unit
- 30 Unit provided with BACnet interface card
- 31 All power and controls connections are tight and snug. (Standard)

DUCTS (PRELIMINARY CHECK)


- 32 Ductwork is properly insulated with continuous vapor barrier.
- 33 Ductwork is installed to facilitate normal equipment operation and maintenance.
- 34 Ductwork is not installed above switchboards or panelboards.
- 35 Duct joint sealants are properly installed. (Standard)
- 36 There are no severe duct restrictions. (Standard)
- 37 Balancing at each low pressure take-off to diffuser. (Standard)

PIPING

- 38 All piping is identified with self-adhesive labels. Labels are located in accessible and visible areas.
- 39 Piping adjacent to equipment is installed to allow service and maintenance.
- 40 Piping is installed free of sags and bends.
- 41 Pipe sleeves are installed at penetrations in exterior walls, roof, and floors

LABELING

- 42 Unit is labeled with self-adhesive labels. Labels are located in accessible and visible areas.
- 43 Unit manufacturer startup complete - upload report

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  DOAS-2**Sections 1**First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Attach image of all unit identification.
- 2 Unit is installed in accordance per design details
- 3 Unit inlet and outlet connections are made with flexible duct.
- 4 Equipment is installed to facilitate service, maintenance, and repair or replacement of components.
- 5 Equipment, piping and valves are supported independently.
- 6 Duct pressure sensor tubing terminated in duct
- 7 Operators, sensors, and control devices are installed to facilitate service, maintenance, and repair or replacement of components.
- 8 Unit is mounted on factory built roof mounting curb.- with vibration isolation
- 9 Curb filled with 6" of insulating sound batt per detail
- 10 Divider in place and sealed between the supply and return.
- 11 P-traps are installed for all drain pans.
- 12 Any bent fins have been repaired by combing coils.
- 13 Unit is clean and installed in as-new condition. (Standard)
- 14 Unit power disconnects are in place and labeled. (Standard)
- 15 All power connections are tight and snug. (Standard)
- 16 Proper grounding is installed for components and unit. (Standard)

FILTER

- 17 Filters are installed and clean. (Standard) - MERV-13 prefilters - 2"
- 18 No air gaps are visible around filters. (Standard)
- 19 Clearance provided for removal of filters. (Standard)
- 20 Spare set of filters provided (23 81 10-1.12)

SUPPLY FAN(S)

- 21 Clearance is provided for service and removal of fan motors. (Standard)

DX COIL

- 22 Condensate drain is routed per attached detail. (M4.1)
- 23 Unit provided with stainless steel or plastic drain pan.
- 24 Drain pan appears to be free of debris and is draining properly (Standard)
- 25 Drain pan high limit switch provided and wired for unit shut down.
- 26 Hail guard provided in DX coil
- 27 No visible growth or accumulation on coil or in drain pan(s). (Standard)

ELECTRICAL AND CONTROLS

- 28 Unit power disconnects are in place and labeled. (Standard)
- 29 Convenience outlet provided on unit
- 30 Unit provided with BACnet interface card
- 31 All power and controls connections are tight and snug. (Standard)

DUCTS (PRELIMINARY CHECK)

- 32 Ductwork is properly insulated with continuous vapor barrier.
- 33 Ductwork is installed to facilitate normal equipment operation and maintenance.
- 34 Ductwork is not installed above switchboards or panelboards.
- 35 Duct joint sealants are properly installed. (Standard)
- 36 There are no severe duct restrictions. (Standard)
- 37 Balancing at each low pressure take-off to diffuser. (Standard)

PIPING

- 38 All piping is identified with self-adhesive labels. Labels are located in accessible and visible areas.
- 39 Piping adjacent to equipment is installed to allow service and maintenance.
- 40 Piping is installed free of sags and bends.
- 41 Pipe sleeves are installed at penetrations in exterior walls, roof, and floors

LABELING

- 42 Unit is labeled with self-adhesive labels. Labels are located in accessible and visible areas.
- 43 Unit manufacturer startup complete - upload report



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-1

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN

- 1 Record Manufacturer:
- 2 Record Model Number:
- 3 Record Serial Number:
- 4 Record Capacity:
- 5 Are permanent labels affixed?
- 6 Is casing condition good: no dents, leaks, door gaskets installed?
- 7 Are mountings checked and shipping bolts removed?
- 8 Are vibration isolators installed?
- 9 Are equipment guards installed?
- 10 Are pulleys aligned?
- 11 Is belt tension correct?
- 12 Are plenums clear of debris?
- 13 Do fans rotate freely?
- 14 Are fire and balance dampers installed?
- 15 Are backdraft dampers installed, per drawings, and operate freely?
- 16 Is duct system complete?
- 17 Are electrical connections complete?
- 18 Is disconnect switch installed?
- 19 Are control connections complete?
- 20 Is fan rotation correct?



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-2

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN

- 1 Record Manufacturer:
- 2 Record Model Number:
- 3 Record Serial Number:
- 4 Record Capacity:
- 5 Are permanent labels affixed?
- 6 Is casing condition good: no dents, leaks, door gaskets installed?
- 7 Are mountings checked and shipping bolts removed?
- 8 Are vibration isolators installed?
- 9 Are equipment guards installed?
- 10 Are pulleys aligned?
- 11 Is belt tension correct?
- 12 Are plenums clear of debris?
- 13 Do fans rotate freely?
- 14 Are fire and balance dampers installed?
- 15 Are backdraft dampers installed, per drawings, and operate freely?
- 16 Is duct system complete?
- 17 Are electrical connections complete?
- 18 Is disconnect switch installed?
- 19 Are control connections complete?
- 20 Is fan rotation correct?



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-3

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN

- 1 Record Manufacturer:
- 2 Record Model Number:
- 3 Record Serial Number:
- 4 Record Capacity:
- 5 Are permanent labels affixed?
- 6 Is casing condition good: no dents, leaks, door gaskets installed?
- 7 Are mountings checked and shipping bolts removed?
- 8 Are vibration isolators installed?
- 9 Are equipment guards installed?
- 10 Are pulleys aligned?
- 11 Is belt tension correct?
- 12 Are plenums clear of debris?
- 13 Do fans rotate freely?
- 14 Are fire and balance dampers installed?
- 15 Are backdraft dampers installed, per drawings, and operate freely?
- 16 Is duct system complete?
- 17 Are electrical connections complete?
- 18 Is disconnect switch installed?
- 19 Are control connections complete?
- 20 Is fan rotation correct?



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-4

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN

- 1 Record Manufacturer:
- 2 Record Model Number:
- 3 Record Serial Number:
- 4 Record Capacity:
- 5 Are permanent labels affixed?
- 6 Is casing condition good: no dents, leaks, door gaskets installed?
- 7 Are mountings checked and shipping bolts removed?
- 8 Are vibration isolators installed?
- 9 Are equipment guards installed?
- 10 Are pulleys aligned?
- 11 Is belt tension correct?
- 12 Are plenums clear of debris?
- 13 Do fans rotate freely?
- 14 Are fire and balance dampers installed?
- 15 Are backdraft dampers installed, per drawings, and operate freely?
- 16 Is duct system complete?
- 17 Are electrical connections complete?
- 18 Is disconnect switch installed?
- 19 Are control connections complete?
- 20 Is fan rotation correct?

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  EF-ISO-1

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN

- 1 Record Manufacturer:
- 2 Record Model Number:
- 3 Record Serial Number:
- 4 Record Capacity:
- 5 Are permanent labels affixed?
- 6 Is casing condition good: no dents, leaks, door gaskets installed?
- 7 Are mountings checked and shipping bolts removed?
- 8 Are vibration isolators installed?
- 9 Are equipment guards installed?
- 10 Are pulleys aligned?
- 11 Is belt tension correct?
- 12 Are plenums clear of debris?
- 13 Do fans rotate freely?
- 14 Are fire and balance dampers installed?
- 15 Are backdraft dampers installed, per drawings, and operate freely?
- 16 Is duct system complete?
- 17 Are electrical connections complete?
- 18 Is disconnect switch installed?
- 19 Are control connections complete?
- 20 Is fan rotation correct?
- 21 Fan discharge 10' above final roof elevation
- 22 Fan volute drain contained to prevent contaminated discharging below 10' above final roof elevation.
- 23 Discharge stack labeled with Biohazard signage
- 24 Room pressure monitor installed
- 25 Room pressure monitor connected to BMS



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-ISO-2

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.


EXHAUST FAN

- 1 Record Manufacturer:
- 2 Record Model Number:
- 3 Record Serial Number:
- 4 Record Capacity:
- 5 Are permanent labels affixed?
- 6 Is casing condition good: no dents, leaks, door gaskets installed?
- 7 Are mountings checked and shipping bolts removed?
- 8 Are vibration isolators installed?
- 9 Are equipment guards installed?
- 10 Are pulleys aligned?
- 11 Is belt tension correct?
- 12 Are plenums clear of debris?
- 13 Do fans rotate freely?
- 14 Are fire and balance dampers installed?
- 15 Are backdraft dampers installed, per drawings, and operate freely?
- 16 Is duct system complete?
- 17 Are electrical connections complete?
- 18 Is disconnect switch installed?
- 19 Are control connections complete?
- 20 Is fan rotation correct?
- 21 Fan discharge 10' above final roof elevation
- 22 Fan volute drain contained to prevent contaminated discharging below 10' above final roof elevation.
- 23 Discharge stack labeled with Biohazard signage
- 24 Room pressure monitor installed
- 25 Room pressure monitor connected to BMS

#126 Equipment Storage 229 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Equipment Storage 229 -
 Wall Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL VACANCY



- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#27 Exam 1 201 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 1 201 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#139 Exam 1 201 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 1 201 - Dimmer
 Switch

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer control installed on wall

#28 Exam 2 202 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 2 202 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#140 Exam 2 202 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 2 202 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer control installed on wall

#29 Exam 3 203 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 3 203 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#141 Exam 3 203 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 3 203 - Dimmer
 Switch

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer control installed on wall

#30 Exam 4 204 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 4 204 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#142 Exam 4 204 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 4 204 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer control installed on wall

#31 Exam 5 205 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 5 205 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#143 Exam 5 205 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 5 205 - Dimmer
 Switch

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer control installed on wall

#32 Exam 6 206 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 6 206 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#144 Exam 6 206 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 6 206 - Dimmer
 Switch

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer control installed on wall

#33 Exam 7 212 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 7 212 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#145 Exam 7 212 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 7 212 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER

- 1 Space dimmer control installed on wall

#59 Exterior Lighting

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Exterior Lighting

Sections 1

First Section **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

EXTERIOR LIGHTING SYSTEM

- 1 BAS cnnctions to pole lighting relay
- 2 BAS cnnctions to bollard lighting relay
- 3 BAS cnnctions to wall pack lighting relay
- 4 BAS cnnctions to canopy lighting relay
- 5 Photocell provided on site and wiring terminated
- 6 Override switchs provided on BAS interface for exterior lighting

#68 FCU 1-1

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-1

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#69 FCU 1-2

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-2

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-3

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

#70 FCU 1-4

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 1-4

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-5

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

#101 FCU 1-6

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-6

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

#71 FCU 1-7

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 1-7

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#72 FCU 1-8

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 1-8

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#102 FCU 1-9

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 1-9

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-10

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

#73 FCU 1-11

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-11

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-12

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

#74 FCU 1-13

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-13

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#75 FCU 1-14

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-14

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#76 FCU 1-15

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-15

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#111 FCU 1-16

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 1-16

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-1

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#78 FCU 2-2

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-2

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#79 FCU 2-3

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-3

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#80 FCU 2-4

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 2-4

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#81 FCU 2-5

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  FCU 2-5

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#82 FCU 2-6

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 2-6

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#83 FCU 2-7

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-7

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#84 FCU 2-8

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-8

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#105 FCU 2-9

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-9

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-10

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

#107 FCU 2-11A

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 2-11A

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 2-11B

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-12

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#86 FCU 2-13

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-13

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
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- 6 Unit is mounted level and plumb and is properly supported.
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- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#87 FCU 2-14

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-14

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#88 FCU 2-15

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-15

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#89 FCU 3-1A

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-1A

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#90 FCU 3-1B

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-1B

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-2

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

#91 FCU 3-3

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-3

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#92 FCU 3-4

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-4

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#93 FCU 3-5

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-5

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
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- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#94 FCU 3-6

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-6

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-7

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#96 FCU 3-8

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-8

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
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- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#110 FCU 3-9

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-9

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -DUCTED

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
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- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-Spring Isolator
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Duct installed per design documents - Size correct and canvas connections at unit
- 13 Balance dampers at all taps
- 14 Fan coil installed within 24" of ceiling
- 15 Condensate pan provided per design details with high limit float switch to shutdown fan
- 16 Control wiring terminated
- 17 Power wiring terminated
- 18 Thermostat labeled
- 19 Unit is permanently Labeled
- 20 Ceiling Grid Labeled with unit information

#112 FCU 3-10

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-10

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
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- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#113 FCU 3-11

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 3-11

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
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- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#114 FCU 3-12

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-12

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
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- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#115 FCU 3-13

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  FCU 3-13

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
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- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#97 FCU 3-14

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-14

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
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- 4 Equipment is clean - including coil
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- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-15

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.



VRF-FAN COIL UNIT -CASSETTE

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Provide picture of unit information tag
- 4 Equipment is clean - including coil
- 5 Manufacturer's required maintenance clearance provided for service
- 6 Unit is mounted level and plumb and is properly supported.
- 7 Unit hangers are per specifications 230548 -3.04-1/2" Rubber mount or hanger
- 8 Clearance for replacing filters is provided.
- 9 Filters are in place without air gaps.
- 10 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 11 Thermostat installed per drawings
- 12 Control wiring terminated
- 13 Power wiring terminated
- 14 Thermostat labeled
- 15 Unit is permanently Labeled
- 16 Ceiling Grid Labeled with unit information

#34 Financial Office 311 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Financial Office 311 -
 Ceiling Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#35 Financial Screen 312 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Financial Screen 312 -
 Ceiling Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#60 Fire Alarm System

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Fire Alarm System

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Attach images of all unit tag data from panel
- 2 Upload final copy of approved fire alarm shop drawings for device installation review

INSTALLATION

- 3 BAS interlock provided to fire alarm system - Alarm
- 4 Utilize uploaded shop drawings above to verify instrumentation
- 5 Fire alarm panel connection to exterior phone line to facilitate dailing out complete
- 6 Fire alarm panel provided with the following functions per 2connected to a Primary and Secondary Power source. The secondary power supply must be sized to provide 5 minutes of operation in alarm conditions after 24 hours of system operation in standby power, All FACPs must provide a separate digital address for each initiating device to facilitate rapid response and maintenance and testing, provide a panel mounted printer to print a log of all status change activity, capable of providing drift compensation, listed and approved as the smoke detector sensitivity test set to reduce maintenance costs. testing, and to reduce disruption,
- 7 Fire alarm panel power supply provided with surge protection

#61 Fire Protection System

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Fire Protection System

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

FIREPROTECTION SYSTEM

- 1 MIC testing record uploaded
- 2 Fire protection pipe pressure test record uploaded
- 3 Fire protection flow test results that established the fire protection design
- 4 Contractor to upload final device layout from approved shop drawings
- 5 All devices in system installed in spaces installed per uploaded, approved device layout
- 6 Double check backflow protection installed in accordance with local requirements.
- 7 Double check backflow protection provided with by-pass or full size meter in accordance with local requirements. Record meter size
- 8 Double check backflow protection installed to prevent freezing
- 9 Wet pipe riser provided with Victaulic preassembled 747 or equal, 2" main test discharge to outside and provide 11"x36" discharge block curbed on 3 sides.
- 10 Electric water gong installed

#127 Fire Riser 307 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Fire Riser 307 - Wall
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL VACANCY



- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#36 Flex 1 213 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 1 213 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#146 Flex 1 213 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 1 213 - Dimmer
 Switch

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer control installed on wall

#37 Flex 2 214 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 2 214 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#147 Flex 2 214 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 2 214 - Dimmer
 Switch

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer control installed on wall

#38 Flex 3 215 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 3 215 - Ceiling
 Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#148 Flex 3 215 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 3 215 - Dimmer
 Switch

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER

- 1 Space dimmer control installed on wall

#157 Generator

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  Generator

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION AND VERIFICATION

- 1 Take a picture of manufacturer tag and ID. Capture all available information as possible in images.

INSTALLATION

- 2 Generator installation is clean and clear of debris
- 3 Generator is secured to concrete housekeeping pad
- 4 Generator is installed on steel base
- 5 Generator is installed on vibration isolation equipment
- 6 Generator mounted on spring isolators
- 7 Provided with flex connection between radiator and exhaust plenum
- 8 Flexible fuel lines provided for connection to generator
- 9 Provided with flex connection at exhaust silencer
- 10 All conduit connections consist of flex conduit
- 11 Generator installed to provide access for periodic maintenance
- 12 Provided with electrically powered, thermostatically controlled jacket water heater to maintain a minimum specified water jacket temperature under ambient temperatures
- 13 Critical grade exhaust silencer provided and installed per design
- 14 Provided with gas proof, stainless steel, flexible exhaust bellows with threaded NPT or flanged connections
- 15 Silencer provided w/ condensate drain
- 16 Rain cap and bird screen provided for exhaust pipe
- 17 A lube oil drain is extended beyond the skid base
- 18 Provided with engine mounted combustion air intake filter with a "blocked filter" indicator
- 19 Emergency stop pushbutton is installed outside of generator enclosure
- 20 Remote annunciation is provided and wired to the generator (annunciator panel, BAS)
- 21 Equipment grounding conductor is installed from generator to grounding electrode system. Flexible jumper is provided between base and isolated generator
- 22 Specified system grounding
- 23 Verify system is grounded as specified

DISPLAY

- 24 Specified display requirements
- 25 Verify display provided as specified
- 26 Display shock mounted to genset

STARTING SYSTEM

- 27 Correct number of starting motors are provided
- 28 Specified starting system and battery accessories
- 29 Verify starting and battery accessories are provided
- 30 Automatic battery charger is provided
- 31 Specified battery charger features and options
- 32 Verify battery charger features are provided

GENERATOR ROOM/ ENCLOSURE

- 33 Room/ enclosure is complete (including doors)
- 34 Room/ enclosure is provided with thermostatically operated space heater
- 35 Louver/ damper installation is complete
- 36 Room/ enclosure provided with bird/rodent screens
- 37 Room/ enclosure provided with emergency lighting
- 38 Convenience receptacles provided
- 39 Required fire protection system rating installed
- 40 Specified sound attenuation provisions
- 41 Verify Sound attenuation provisions are provided



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset GWH

Sections 1**First Section** NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Attach images of all unit tag data.

INSTALLATION

- 2 intake filter in place and clean
- 3 Shutoff valves are installed on domestic-water-supply piping to domestic water heaters and on domestic-hot-water outlet piping.
- 4 Combination temperature-and-pressure relief valves are installed. Relief-valve outlet and drain piping are extended with continuous downward pitch to nearest floor drain.
- 5 Unit mounted to wall via studs/blocking as required by manufacturer
- 6 Unit installed with condensate neutralization trap.
- 7 Hot water outlet piping provided with the following accessories (22 34 00 - 3.01):Thermometer Well, thermometer, strainer, pressure gauge, shutoff valve
- 8 Hot water return piping provided with the following accessories (22 34 00 - 3.01):Thermometer Well, thermometer, pressure gauge, shutoff valve
- 9 Equipment is installed to facilitate service, maintenance, and repair or replacement of components.
- 10 Natural gas piping provided with the following accessories (22 34 00 - 3.01):pressure gauge, shutoff valve, strainer, pressure reducing valve
- 11 Equipment is installed level and plumb.
- 12 Unit is clean and installed in as-new condition. (Standard)

CONTROLS

- 13 Unit power disconnects are in place and labeled. (Standard)
- 14 All power connections are tight and snug. (Standard)
- 15 Proper grounding is installed for components and unit. (Standard)
- 16 All control wiring is completed. (Standard)

INSULATION

- 17 Piping properly insulated with continuous vapor barrier (also fittings, and instrument connections for thermometers and pressure gauges).


LABELING

- 18 Permanent labels are installed on all equipment. Labels are installed in accessible and visible locations.

- 19 Pipe labels are located where piping is exposed or above ceilings and a maximum of 20' spacing between labels. Arrows are used to indicate direction of flow.
 - 20 Tags are installed on piping valves and control devices.
-

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  H1A

Sections 1

First Section  NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Before starting take a picture of the Manufacturer TAG on equipment with all available information in the picture.
- 2 Record Manufacturer:
- 3 Record Model Number:
- 4 Record Main-Specified:
- 5 Record Main-Installed:
- 6 Record Bus Rating- Specified:
- 7 Record Bus Rating- Installed:
- 8 Record Voltage- Specified:
- 9 Record Voltage- Installed:
- 10 Record Fault Current Rating- Specified:
- 11 Record Fault Current Rating- Installed:
- 12 Verify three or four wire configuration:
- 13 Verify wire is properly installed and suitable size for breaker
- 14 Record wire size:

INSTALLATION

- 15 Verify equipment interiors are complete and clean, no physical damage or debris is visible.
- 16 Verify equipment installed per manufacturer's instructions and specifications
- 17 Verify equipment installed agrees with shop drawings and specifications
- 18 Verify mounting, location and clearances are per plans and specifications (reference NEC 110.26)
- 19 Inspect panels and doors for proper fit and alignment
- 20 Verify correct circuit breaker sizes and types per the specifications and manufacturer's drawings
- 21 Verify the application of manufacturer recommended torque values applied to bolted connections
- 22 Inspect insulators, barriers and shields for damage or contamination
- 23 Verify barriers are installed between sections


- 24 Verify that the ground bus is properly bonded to enclosure, enclosure is grounded and resistance to ground meets grounding specifications
- 25 Verify no taps or splices were created in panel
- 26 Filler plates installed on unused spaces
- 27 Verify future extensions from either end are provided with pre-drilled bolt holes and connecting links for the main phase, neutral and ground bus
- 28 Verify enclosure options provided per specification

INSTRUMENTATION

- 29 Specified metering requirements
- 30 Verify metering provided as specified
- 31 Inspect and insure display and control unit are visible and accessible

IDENTIFICATION

- 32 Verify specified material and items to be included on panelboard label
- 33 Verify specified color coding
- 34 Verify label installed as specified and permanently affixed
- 35 Verify any specified additional labeling requirements
- 36 Verify additional labeling is complete
- 37 Verify specified conductor color coding
- 38 Verify conductors are properly color coded
- 39 Verify proper warning labels are installed
- 40 Verify circuit breakers are installed and trip settings are set to the proper setting.
- 41 Verify panelboard directory is legible, complete, and mounted to the back of the panelboard door.

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  H1B**Sections 1**First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Before starting take a picture of the Manufacturer TAG on equipment with all available information in the picture.
- 2 Record Manufacturer:
- 3 Record Model Number:
- 4 Record Main-Specified:
- 5 Record Main-Installed:
- 6 Record Bus Rating- Specified:
- 7 Record Bus Rating- Installed:
- 8 Record Voltage- Specified:
- 9 Record Voltage- Installed:
- 10 Record Fault Current Rating- Specified:
- 11 Record Fault Current Rating- Installed:
- 12 Verify three or four wire configuration:
- 13 Verify wire is properly installed and suitable size for breaker
- 14 Record wire size:

INSTALLATION

- 15 Verify equipment interiors are complete and clean, no physical damage or debris is visible.
- 16 Verify equipment installed per manufacturer's instructions and specifications
- 17 Verify equipment installed agrees with shop drawings and specifications
- 18 Verify mounting, location and clearances are per plans and specifications (reference NEC 110.26)
- 19 Inspect panels and doors for proper fit and alignment
- 20 Verify correct circuit breaker sizes and types per the specifications and manufacturer's drawings
- 21 Verify the application of manufacturer recommended torque values applied to bolted connections
- 22 Inspect insulators, barriers and shields for damage or contamination
- 23 Verify barriers are installed between sections

- 24 Verify that the ground bus is properly bonded to enclosure, enclosure is grounded and resistance to ground meets grounding specifications
- 25 Verify no taps or splices were created in panel
- 26 Filler plates installed on unused spaces
- 27 Verify future extensions from either end are provided with pre-drilled bolt holes and connecting links for the main phase, neutral and ground bus
- 28 Verify enclosure options provided per specification

INSTRUMENTATION

- 29 Specified metering requirements
- 30 Verify metering provided as specified
- 31 Inspect and insure display and control unit are visible and accessible

IDENTIFICATION

- 32 Verify specified material and items to be included on panelboard label
- 33 Verify specified color coding
- 34 Verify label installed as specified and permanently affixed
- 35 Verify any specified additional labeling requirements
- 36 Verify additional labeling is complete
- 37 Verify specified conductor color coding
- 38 Verify conductors are properly color coded
- 39 Verify proper warning labels are installed
- 40 Verify circuit breakers are installed and trip settings are set to the proper setting.
- 41 Verify panelboard directory is legible, complete, and mounted to the back of the panelboard door.

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  HK-1**Sections 1****First Section** NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Attach images of all unit tag data.

INSTALLATION

- 2 Verify unit capable of operation with potable water stream.
- 3 Shutoff valves are installed on domestic-water-supply piping to and from heater along with union connections.
- 4 Equipment is installed level and plumb.
- 5 Unit is clean and installed in as-new condition. (Standard)

CONTROLS

- 6 Unit power disconnects are in place and labeled. (Standard)
- 7 All power connections are tight and snug. (Standard)
- 8 Proper grounding is installed for components and unit. (Standard)
- 9 All control wiring is completed. (Standard)

INSULATION

- 10 Piping properly insulated with continuous vapor barrier (also fittings, and instrument connections for thermometers and pressure gauges).

LABELING

- 11 Permanent labels are installed on all equipment. Labels are installed in accessible and visible locations.
- 12 Pipe labels are located where piping is exposed or above ceilings and a maximum of 20' spacing between labels. Arrows are used to indicate direction of flow.
- 13 Tags are installed on piping valves and control devices.

#128 HSKP 302 - Wall

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  HSKP 302 - Wall Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#12 HWWS Station 415 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  HWWS Station 415 -
 Ceiling Occupancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#156 Info 101 - Daylight

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Info 101 - Daylight

Sections 1

First Section **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

DAYLIGHT CONTROL

- 1 Space photocell sensor installed in ceiling

#63 Irrigation System

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  Irrigation System

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

IRRIGATION SYSTEM

- 1 Upload final approved shop drawings with sprinkler head location and type
- 2 Irrigation System backflow preventer in place
- 3 Irrigation system backflow preventer protected from freezing
- 4 Irrigation system controller in place
- 5 Irrigation system controller power connected
- 6 Irrigation system rain sensor installed and wiring terminated
- 7 Irrigation system heads in locations per uploaded shop drawings
- 8 Irrigation system tubing installed per uploaded shop drawings



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset L1A

Sections 1**First Section** NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Before starting take a picture of the Manufacturer TAG on equipment with all available information in the picture.
- 2 Record Manufacturer:
- 3 Record Model Number:
- 4 Record Main-Specified:
- 5 Record Main-Installed:
- 6 Record Bus Rating- Specified:
- 7 Record Bus Rating- Installed:
- 8 Record Voltage- Specified:
- 9 Record Voltage- Installed:
- 10 Record Fault Current Rating- Specified:
- 11 Record Fault Current Rating- Installed:
- 12 Verify three or four wire configuration:
- 13 Verify wire is properly installed and suitable size for breaker
- 14 Record wire size:

INSTALLATION

- 15 Verify equipment interiors are complete and clean, no physical damage or debris is visible.
- 16 Verify equipment installed per manufacturer's instructions and specifications
- 17 Verify equipment installed agrees with shop drawings and specifications
- 18 Verify mounting, location and clearances are per plans and specifications (reference NEC 110.26)
- 19 Inspect panels and doors for proper fit and alignment
- 20 Verify correct circuit breaker sizes and types per the specifications and manufacturer's drawings
- 21 Verify the application of manufacturer recommended torque values applied to bolted connections
- 22 Inspect insulators, barriers and shields for damage or contamination
- 23 Verify barriers are installed between sections

- 24 Verify that the ground bus is properly bonded to enclosure, enclosure is grounded and resistance to ground meets grounding specifications
- 25 Verify no taps or splices were created in panel
- 26 Filler plates installed on unused spaces
- 27 Verify future extensions from either end are provided with pre-drilled bolt holes and connecting links for the main phase, neutral and ground bus
- 28 Verify enclosure options provided per specification

INSTRUMENTATION

- 29 Specified metering requirements
- 30 Verify metering provided as specified
- 31 Inspect and insure display and control unit are visible and accessible

IDENTIFICATION

- 32 Verify specified material and items to be included on panelboard label
- 33 Verify specified color coding
- 34 Verify label installed as specified and permanently affixed
- 35 Verify any specified additional labeling requirements
- 36 Verify additional labeling is complete
- 37 Verify specified conductor color coding
- 38 Verify conductors are properly color coded
- 39 Verify proper warning labels are installed
- 40 Verify circuit breakers are installed and trip settings are set to the proper setting.
- 41 Verify panelboard directory is legible, complete, and mounted to the back of the panelboard door.



NOT STARTED

0% Yes | 0% No | 0% N/A

Asset L1B

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Before starting take a picture of the Manufacturer TAG on equipment with all available information in the picture.
- 2 Record Manufacturer:
- 3 Record Model Number:
- 4 Record Main-Specified:
- 5 Record Main-Installed:
- 6 Record Bus Rating- Specified:
- 7 Record Bus Rating- Installed:
- 8 Record Voltage- Specified:
- 9 Record Voltage- Installed:
- 10 Record Fault Current Rating- Specified:
- 11 Record Fault Current Rating- Installed:
- 12 Verify three or four wire configuration:
- 13 Verify wire is properly installed and suitable size for breaker
- 14 Record wire size:

INSTALLATION

- 15 Verify equipment interiors are complete and clean, no physical damage or debris is visible.
- 16 Verify equipment installed per manufacturer's instructions and specifications
- 17 Verify equipment installed agrees with shop drawings and specifications
- 18 Verify mounting, location and clearances are per plans and specifications (reference NEC 110.26)
- 19 Inspect panels and doors for proper fit and alignment
- 20 Verify correct circuit breaker sizes and types per the specifications and manufacturer's drawings
- 21 Verify the application of manufacturer recommended torque values applied to bolted connections
- 22 Inspect insulators, barriers and shields for damage or contamination
- 23 Verify barriers are installed between sections


- 24 Verify that the ground bus is properly bonded to enclosure, enclosure is grounded and resistance to ground meets grounding specifications
- 25 Verify no taps or splices were created in panel
- 26 Filler plates installed on unused spaces
- 27 Verify future extensions from either end are provided with pre-drilled bolt holes and connecting links for the main phase, neutral and ground bus
- 28 Verify enclosure options provided per specification

INSTRUMENTATION

- 29 Specified metering requirements
- 30 Verify metering provided as specified
- 31 Inspect and insure display and control unit are visible and accessible

IDENTIFICATION

- 32 Verify specified material and items to be included on panelboard label
- 33 Verify specified color coding
- 34 Verify label installed as specified and permanently affixed
- 35 Verify any specified additional labeling requirements
- 36 Verify additional labeling is complete
- 37 Verify specified conductor color coding
- 38 Verify conductors are properly color coded
- 39 Verify proper warning labels are installed
- 40 Verify circuit breakers are installed and trip settings are set to the proper setting.
- 41 Verify panelboard directory is legible, complete, and mounted to the back of the panelboard door.

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  L1C**Sections 1****First Section** NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Before starting take a picture of the Manufacturer TAG on equipment with all available information in the picture.
- 2 Record Manufacturer:
- 3 Record Model Number:
- 4 Record Main-Specified:
- 5 Record Main-Installed:
- 6 Record Bus Rating- Specified:
- 7 Record Bus Rating- Installed:
- 8 Record Voltage- Specified:
- 9 Record Voltage- Installed:
- 10 Record Fault Current Rating- Specified:
- 11 Record Fault Current Rating- Installed:
- 12 Verify three or four wire configuration:
- 13 Verify wire is properly installed and suitable size for breaker
- 14 Record wire size:

INSTALLATION

- 15 Verify equipment interiors are complete and clean, no physical damage or debris is visible.
- 16 Verify equipment installed per manufacturer's instructions and specifications
- 17 Verify equipment installed agrees with shop drawings and specifications
- 18 Verify mounting, location and clearances are per plans and specifications (reference NEC 110.26)
- 19 Inspect panels and doors for proper fit and alignment
- 20 Verify correct circuit breaker sizes and types per the specifications and manufacturer's drawings
- 21 Verify the application of manufacturer recommended torque values applied to bolted connections
- 22 Inspect insulators, barriers and shields for damage or contamination
- 23 Verify barriers are installed between sections

- 24 Verify that the ground bus is properly bonded to enclosure, enclosure is grounded and resistance to ground meets grounding specifications
- 25 Verify no taps or splices were created in panel
- 26 Filler plates installed on unused spaces
- 27 Verify future extensions from either end are provided with pre-drilled bolt holes and connecting links for the main phase, neutral and ground bus
- 28 Verify enclosure options provided per specification

INSTRUMENTATION

- 29 Specified metering requirements
- 30 Verify metering provided as specified
- 31 Inspect and insure display and control unit are visible and accessible

IDENTIFICATION



- 32 Verify specified material and items to be included on panelboard label
- 33 Verify specified color coding
- 34 Verify label installed as specified and permanently affixed
- 35 Verify any specified additional labeling requirements
- 36 Verify additional labeling is complete
- 37 Verify specified conductor color coding
- 38 Verify conductors are properly color coded
- 39 Verify proper warning labels are installed
- 40 Verify circuit breakers are installed and trip settings are set to the proper setting.
- 41 Verify panelboard directory is legible, complete, and mounted to the back of the panelboard door.

#13 Lab 104 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Lab 104 - Ceiling
 Occupancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#117 Lab 423 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Lab 423 - Occupancy

Sections 1

First Section **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.



WALL OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#129 MDF/Security 303 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  MDF/Security 303 - Wall
 Vacancy


Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  MDP**Sections 1****First Section** NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

DOCUMENTATION

- 1 Before starting take a picture of the Manufacturer TAG on equipment with all available information in the picture.
- 2 Record Manufacturer:
- 3 Record Model Number:
- 4 Record Main-Specified:
- 5 Record Main-Installed:
- 6 Record Bus Rating- Specified:
- 7 Record Bus Rating- Installed:
- 8 Record Voltage- Specified:
- 9 Record Voltage- Installed:
- 10 Record Fault Current Rating- Specified:
- 11 Record Fault Current Rating- Installed:
- 12 Verify three or four wire configuration:
- 13 Verify wire is properly installed and suitable size for breaker
- 14 Record wire size:

INSTALLATION

- 15 Verify equipment interiors are complete and clean, no physical damage or debris is visible.
- 16 Verify equipment installed per manufacturer's instructions and specifications
- 17 Verify equipment installed agrees with shop drawings and specifications
- 18 Verify mounting, location and clearances are per plans and specifications (reference NEC 110.26)
- 19 Inspect panels and doors for proper fit and alignment
- 20 Verify correct circuit breaker sizes and types per the specifications and manufacturer's drawings
- 21 Verify the application of manufacturer recommended torque values applied to bolted connections
- 22 Inspect insulators, barriers and shields for damage or contamination
- 23 Verify barriers are installed between sections

- 24 Verify that the ground bus is properly bonded to enclosure, enclosure is grounded and resistance to ground meets grounding specifications
- 25 Verify no taps or splices were created in panel
- 26 Filler plates installed on unused spaces
- 27 Verify future extensions from either end are provided with pre-drilled bolt holes and connecting links for the main phase, neutral and ground bus
- 28 Verify enclosure options provided per specification

INSTRUMENTATION

- 29 Specified metering requirements
- 30 Verify metering provided as specified
- 31 Inspect and insure display and control unit are visible and accessible



IDENTIFICATION

- 32 Verify specified material and items to be included on panelboard label
- 33 Verify specified color coding
- 34 Verify label installed as specified and permanently affixed
- 35 Verify any specified additional labeling requirements
- 36 Verify additional labeling is complete
- 37 Verify specified conductor color coding
- 38 Verify conductors are properly color coded
- 39 Verify proper warning labels are installed
- 40 Verify circuit breakers are installed and trip settings are set to the proper setting.
- 41 Verify panelboard directory is legible, complete, and mounted to the back of the panelboard door.

#130 Med Gas 305 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Med Gas 305 - Wall
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL VACANCY



- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#14 Mens 107 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Mens 107 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#118 Mens 107 -



Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Mens 107 - Occupancy

Sections 1

First Section **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.



WALL OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#39 Mothers Rm 313 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Mothers Rm 313 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#149 Mothers Rm 313 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Mothers Rm 313 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER

- 1 Space dimmer control installed on wall

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  MS-1A**Sections 1**First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

CRAC UNIT

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Equipment is clean.
- 4 Manufacturer's required maintenance clearance provided for service (Also, see attached enlarged plan)
- 5 Unit is mounted level and plumb and is properly supported.
- 6 Clearance for replacing filters is provided.
- 7 Filters are in place without air gaps.
- 8 Unit provided with integral condensate pump with float switch and reservoir under coil assembly.
- 9 Thermostat installed per drawings.
- 10 Unit is permanently Labeled



CONDENSING UNIT

- 11 Record Manufacturer (In Note)
- 12 Record Model Number (In Note)
- 13 Equipment is clean.
- 14 Manufacturer's required maintenance clearance provided for service (Also, see attached enlarged plan)
- 15 Unit is mounted level and plumb and is properly supported.
- 16 Unit is permanently Labeled

#40 Multi-Function 110 Left - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Multi-Function 110 Left -
 Ceiling Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#41 Multi-Function 110 Right - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Multi-Function 110 Right -
 Ceiling Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  ODU-1

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VRF CONDENSING UNIT

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Equipment is clean.
- 4 Manufacturer's required maintenance clearance provided for service (Also, see attached enlarged plan)
- 5 Unit is mounted level and plumb and is properly supported.
- 6 Pipe curb in place and sealed to prevent ingress of insects
- 7 Control wiring terminated
- 8 Mounted on rubber isolation pads per design specifications
- 9 Bolted down to roof equipment curb
- 10 Refrigerant piping system reviewed by local manufacturers representative (upload letter of acceptance)
- 11 Heat recovery boxes installed per design documents
- 12 Power wiring terminated to condensing unit
- 13 Disconnect installed at unit per design documents
- 14 Disconnect labeled per design documents
- 15 Refrigerant piping system provided with shutoff valves at each heat recovery unit or at each indoor unit as required per design documents
- 16 Insulation per design documents (1-1/2" on all refrigerant piping except dedicated liquid lines that are 1")
- 17 Pipe pressure tests uploaded here to document system pressure testing
- 18 Unit is permanently Labeled

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  ODU-2**Sections 1**First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VRF CONDENSING UNIT

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Equipment is clean.
- 4 Manufacturer's required maintenance clearance provided for service (Also, see attached enlarged plan)
- 5 Unit is mounted level and plumb and is properly supported.
- 6 Pipe curb in place and sealed to prevent ingress of insects
- 7 Control wiring terminated
- 8 Mounted on rubber isolation pads per design specifications
- 9 Bolted down to roof equipment curb
- 10 Refrigerant piping system reviewed by local manufacturers representative (upload letter of acceptance)
- 11 Heat recovery boxes installed per design documents
- 12 Power wiring terminated to condensing unit
- 13 Disconnect installed at unit per design documents
- 14 Disconnect labeled per design documents
- 15 Refrigerant piping system provided with shutoff valves at each heat recovery unit or at each indoor unit as required per design documents
- 16 Insulation per design documents (1-1/2" on all refrigerant piping except dedicated liquid lines that are 1")
- 17 Pipe pressure tests uploaded here to document system pressure testing
- 18 Unit is permanently Labeled

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  ODU-3

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VRF CONDENSING UNIT

- 1 Record Manufacturer:
- 2 Record Model Number (In Note)
- 3 Equipment is clean.
- 4 Manufacturer's required maintenance clearance provided for service (Also, see attached enlarged plan)
- 5 Unit is mounted level and plumb and is properly supported.
- 6 Pipe curb in place and sealed to prevent ingress of insects
- 7 Control wiring terminated
- 8 Mounted on rubber isolation pads per design specifications
- 9 Bolted down to roof equipment curb
- 10 Refrigerant piping system reviewed by local manufacturers representative (upload letter of acceptance)
- 11 Heat recovery boxes installed per design documents
- 12 Power wiring terminated to condensing unit
- 13 Disconnect installed at unit per design documents
- 14 Disconnect labeled per design documents
- 15 Refrigerant piping system provided with shutoff valves at each heat recovery unit or at each indoor unit as required per design documents
- 16 Insulation per design documents (1-1/2" on all refrigerant piping except dedicated liquid lines that are 1")
- 17 Pipe pressure tests uploaded here to document system pressure testing
- 18 Unit is permanently Labeled

#131 Panorex 405 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Panorex 405 - Wall
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.


WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#119 Pat Toilet 419 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Pat Toilet 419 -
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL OCCUPANCY


- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#42 Ped 1 216 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Ped 1 216 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#150 Ped 1 216 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Ped 1 216 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer control installed on wall

#43 Ped 2 217 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Ped 2 217 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#151 Ped 2 217 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Ped 2 217 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER


- 1 Space dimmer control installed on wall

#66 Plumbing System -

Misc

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  Plumbing System - Misc

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.



GENERAL PLUMBING SYSTEM

- 1 BAC-T testing record uploaded
- 2 Domestic pipe pressure test record uploaded
- 3 Sanitary sewer pipe pressure test record uploaded
- 4 All piping insulated per specifications: Domestic hot water and hot water recirculation - Pipe sizes 1-1/4" and less - 1" thickness--Pipe sizes 1-1/2" and greater - insulation thickness 1-1/2"
- 5 All piping insulated per specifications: Domestic cold water - All-1/2"
- 6 All piping insulated per specifications: Roof drain body and horizontals - 1" - All Sizes
- 7 Hot water to sinks and showers discharge between 100F and 115F
- 8 All toilets flush correctly with out sloshing and spraying
- 9 Backflow prevention on domestic water certified - upload picture or copy of certification

#44 Procedure 207 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Procedure 207 - Ceiling
 Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#152 Procedure 207 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Procedure 207 - Dimmer
 Switch

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer control installed on wall

#153 PVT Adult 407 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  PVT Adult 407 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer control installed on wall

#154 PVT Adult 408 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  PVT Adult 408 - Dimmer
 Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER

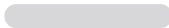
- 1 Space dimmer control installed on wall

#132 Soiled Holding 228 -



Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED



0% Yes | 0% No | 0% N/A

Asset  Soiled Holding 228 - Wall
 Vacancy

Sections 1

First Section

NOT STARTED



Status set by Justin Hethcote on 8/15/2021.


WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#120 Spec Tlt 222 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Spec Tlt 222 - Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#45 Speciality Exam 208 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Speciality Exam 208 -
 Ceiling Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#155 Speciality Exam 208 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Speciality Exam 208 -
 Dimmer Switch

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer control installed on wall

#15 Staff Tlt 233 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Staff Tlt 233 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling


#121 Staff Tlt 233 -



Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  Staff Tlt 233 - Occupancy

Sections 1

First Section NOT STARTED

Status set by Justin Hethcote on 8/15/2021.



WALL OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#122 Staff Toilet 422 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Staff Toilet 422 -
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#123 Staff Toilet 501 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Staff Toilet 501 -
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#46 Sterilization 421 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Sterilization 421 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#47 Storage 111 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Storage 111 - Ceiling
 Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#48 Storage 224 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Storage 224 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

CEILING VACANCY

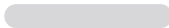
- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#133 Storage 406 - Wall



Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED



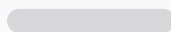
0% Yes | 0% No | 0% N/A

Asset  Storage 406 - Wall
 Vacancy

Sections 1

First Section

NOT STARTED



Status set by Justin Hethcote on 8/15/2021.



WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#134 Touchdown 1 220 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Touchdown 1 220 - Wall
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#135 Touchdown 4 401 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Touchdown 4 401 - Wall
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#136 Touchdown 5 402- Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Touchdown 5 402- Wall
 Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#137 VAC 306 - Wall

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  VAC 306 - Wall Vacancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

#16 Vaccine 219 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Vaccine 219 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#49 Vaccine 219 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Vaccine 219 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

CEILING VACANCY



- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#17 Vestibule 100 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Vestibule 100 - Ceiling
 Occupancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#50 Vitals 223 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Vitals 223 - Ceiling
 Vacancy

Sections 1

First Section **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



CEILING VACANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#18 Waiting 102 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Waiting 102 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#19 Womens 106 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Womens 106 - Ceiling
 Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.


CEILING OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space vacancy sensor installed in ceiling

#124 Womens 106 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Womens 106 - Occupancy

Sections 1

First Section NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL OCCUPANCY

- 1 Space lighting fixtures installed per design documents.
- 2 Space occupancy sensor installed on wall

Tests

154 Tests sorted by name





Gresham Smith

Gresham Smith | Central Health: Del Valle | 45205.00

#109 Admin Office 309 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Admin Office 309 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#110 Admin Office 310 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Admin Office 310 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#2 BMS Utility Meters

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset BMS Utility Meters

Attempts Most Recent

Attempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.



INSTALLATION

- 1 BMS dashboard recording natural gas consumption of facility - record current value
- 2 BMS dashboard recording domestic water consumption of facility - record current value
- 3 BMS dashboard recording electrical consumption of facility - record current value

#111 Breakdown/Receiving 231 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Breakdown/Receiving 231
 - Ceiling Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#112 BreakRoom 232 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  BreakRoom 232 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#113 Cambra 195 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Cambra 195 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#114 Clean Work 226 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Clean Work 226 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VACANCY



- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#115 CLIA 221 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  CLIA 221 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#83 Collaboration 200 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Collaboration 200 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#84 Collaboration Space 403 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Collaboration Space 403 -
 Ceiling Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#116 Conference 300 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Conference 300 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#65 Conference 300 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Conference 300 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#85 Corridor 105 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 105 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#86 Corridor 209 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 209 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#87 Corridor 218 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 218 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#88 Corridor 227 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 227 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#89 Corridor 230 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 230 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#90 Corridor 315 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 315 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#91 Corridor 404 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 404 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#92 Corridor 424 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Corridor 424 - Ceiling
 Occupancy


Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  CP**Attempts** Most RecentAttempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

POINT VERIFICATION

- 1 Record: Recirc Pump Status
- 2 Record: return water temperature actual
- 3 Record: Recirc Pump Command (Start/Stop)
- 4 Record: Operating schedule of pump (initially 7AM-6PM)

SYSTEM OFF

- 5 Test Procedure: Simulate pump outside occupied hours of operation
- 6 Expected Response: Pump turns off.
- 7 Expected Response: BAS is updated to indicate pump is off.
- 8 Test Procedure: Simulate pump inside occupied hours of operation
- 9 Expected Response: Pump turns on.
- 10 Expected Response: BAS is updated to indicate pump is on.

ALARM

- 11 Test Procedure: Simulate domestic water is above 150F
- 12 Expected response: Alarm is initiated
- 13 Test Procedure: Simulate domestic water is below 130F
- 14 Expected response: Alarm is initiated
- 15 Test Procedure: Simulate pump is commanded on but does not engage by opening disconnect switch
- 16 Expected response: Level 3 alarm is initiated



NOT STARTED



0% Yes | 0% No | 0% N/A

Asset DOAS-1

Attempts Most Recent

Attempt No. 1

NOT STARTED



Status set by Justin Hethcote on 8/15/2021.

POINT VERIFICATION

- 1 Record: SA Fan Status
- 2 Record: SA Fan Command
- 3 Record: Damper/ Airflow Values
- 4 Record: SA Fan Speed
- 5 Record: SA Fan Speed Feedback
- 6 Record: TAB Discharge air Temperature (upstream of fan) and BAS Discharge air temperature
- 7 Record: TAB Return air Temperature and BAS Return air temperature
- 8 Record: TAB Supply air Temperature (downstream of fan) and BAS Discharge air temperature
- 9 Record: TAB outside air Temperature and BAS outside air temperature
- 10 Record: TAB outdoor air humidity and BAS outdoor air humidity
- 11 Record: TAB Supply air humidity and BAS outdoor air humidity
- 12 Record: TAB Duct static pressure and BAS Duct static pressure
- 13 Record: Dehumidification Status
- 14 Record: Heating Status (% output)
- 15 Record: Cooling Capacity (% output)
- 16 Record: Occupancy Status
- 17 Record: Discharge air pressure and BAS Discharge air pressure
- 18 Record: Discharge air pressure setpoint
- 19 Record: Space CO2 reading

UNIT OFF

- 20 Test Procedure: Initiate unit shutdown via BAS.
- 21 Expected Response: SF's Stop
- 22 Expected Response: Any Interlocked EF's Stop. (Record Values)
- 23 Expected Response: OA Damper closes.
- 24 Expected Response: BAS updates to indicate new conditions.

UNIT ON

- 25 Test Procedure: Initiate unit start-up via BAS.

- 26 Expected Response: OA Damper opens
- 27 Expected Response: SF's start after adjustable time delay. (Record Values)
- 28 Expected Response: Any Interlocked EF's start. (Record Values)
- 29 Expected Response: DX cooling OR heating controls to DAT Setpoint (Record Values)
- 30 Expected Response: SF's control to DP Setpoint (Record Values)
- 31 Expected Response: BAS updates to indicate new conditions.

SUPPLY FAN CONTROL

- 32 Record: Initial Values
- 33 Test Procedure: Raise DP Setpoint OR simulate DP Actual is < Setpoint
- 34 Expected Response: Supply Fan VFD modulates up to meet/maintain DP Setpoint. (Record Values)

OCCUPIED/UNOCCUPIED MODE

- 35 Record: Facility operating occupancy schedules
- 36 Test Procedure: Simulate Building is unoccupied
- 37 Expected Response: After time delay unit disengages
- 38 Expected Response: Interlocked EF disengages
- 39 Expected Response: BAS Updates to indicate each condition
- 40 Test Procedure: While simulating that building is unoccupied - engage an override in the building
- 41 Expected Response: After time delay unit engages into occupied mode
- 42 Expected Response: Interlocked EF engages
- 43 Expected Response: BAS Updates to indicate each condition
- 44 Test Procedure: Simulate Building is unoccupied
- 45 Expected Response: Interlocked EF engages
- 46 Expected Response: Outside air damper modulates closed
- 47 Expected Response: BAS Updates to indicate each condition

DOAS CO2 CONTROL


- 48 Record: Initial Values of CO2 reading and setpoint
- 49 Test Procedure: Simulate CO2 level is below setpoint by changing setpoint to 150 PPM above current reading
- 50 Expected Response: DOAS engages into minimum outside air flow setpoint
- 51 Expected Response: Fan modulates VFD up to meet/maintain new DP Setpoint. (Record Values)
- 52 Expected Response: Building remains positively pressurized with exhaust at normally balanced flow - Record building pressure to exterior at exterior door with all exterior doors closed (Record Value in W.C.)
- 53 Expected Response: BAS Updates to indicate each condition
- 54 Test Procedure: Simulate CO2 level is above maximum setpoint by changing setpoint to 150 PPM below current reading
- 55 Expected Response: DOAS engages into maximum outside air flow setpoint
- 56 Expected Response: Fan modulates VFD up to meet/maintain new DP Setpoint. (Record Values)
- 57 Expected Response: Building remains positively pressurized with exhaust at normally balanced flow without too much overpressure - Record building pressure to exterior at exterior door with all exterior doors closed (Record Value in W.C.)
- 58 Expected Response: BAS Updates to indicate each condition

DISCHARGE AIR CONTROL

- | | |
|----|--|
| 59 | Record: Outside air high limit Temperature -75F design value |
| 60 | Record: Outside air low limit Temperature -70F design value |
| 61 | Record: Outside air high limit Dewpoint - 55F design value |
| 62 | Test Procedure: Simulate outside air temperature is above high limit setpoint - Change highlimit temperature setpoint if necessary. Set other setpoints out of the way to facilitate testing (lower low limit to 5 degrees below outside air current temperature and dewpoint to 90F) |
| 63 | Expected Response: Unit engages compressors to produce 73F air. |
| 64 | Expected Response: BAS Updates to indicate each condition |
| 65 | Test Procedure: Simulate outside air temperature is below low limit setpoint - Change low limit temperature setpoint if necessary. Set other setpoints out of the way to facilitate testing (raise high limit to 5 degrees above outside air current temperature and dewpoint to 90F) |
| 66 | Expected Response: Unit engages SCR heater to produce 71F air. |
| 67 | Expected Response: BAS Updates to indicate each condition |
| 68 | Test Procedure: Simulate outside air temperature is above dewpoint limit setpoint - Change dewpoint temperature limit temperature setpoint if necessary. Set other setpoints out of the way to facilitate testing (low limit to 5 degrees below current temperature high limit to 5 degrees above current outside air temperature) |
| 69 | Expected Response: Unit engages compressor to 100% cooling and modulates hot gas reheat to maintain DAT setpoint |
| 70 | Expected Response: BAS Updates to indicate each condition |
| 71 | Test Procedure: Simulate outside air temperature is below dewpoint high limit setpoint; below high limit and above low limit - Set setpoints accordingly based on outside air conditions. |
| 72 | Expected Response: Unit disengages compressors and heat coil in economizer mode |
| 73 | Expected Response: BAS Updates to indicate each condition |

ALARMS

- | | |
|----|---|
| 74 | Level 2 alarm produced when supply fan status does not match commanded value after time delay (record time delay) |
| 75 | Level 2 alarm produced when discharge air humidity is greater than 55%RH after time delay (record time delay) |
| 76 | Level 3 alarm produced when CO2 sensor reads less than 400 PPM or greater than 2,000 PPM after time delay (record time delay) |
| 77 | Expected Response: BAS Updates to indicate each condition |

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  DOAS-2**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

POINT VERIFICATION

- 1 Record: SA Fan Status
- 2 Record: SA Fan Command
- 3 Record: Damper/ Airflow Values
- 4 Record: SA Fan Speed
- 5 Record: SA Fan Speed Feedback
- 6 Record: TAB Discharge air Temperature (upstream of fan) and BAS Discharge air temperature
- 7 Record: TAB Return air Temperature and BAS Return air temperature
- 8 Record: TAB Supply air Temperature (downstream of fan) and BAS Discharge air temperature
- 9 Record: TAB outside air Temperature and BAS outside air temperature
- 10 Record: TAB outdoor air humidity and BAS outdoor air humidity
- 11 Record: TAB Supply air humidity and BAS outdoor air humidity
- 12 Record: TAB Duct static pressure and BAS Duct static pressure
- 13 Record: Dehumidification Status
- 14 Record: Heating Status (% output)
- 15 Record: Cooling Capacity (% output)
- 16 Record: Occupancy Status
- 17 Record: Discharge air pressure and BAS Discharge air pressure
- 18 Record: Discharge air pressure setpoint
- 19 Record: Space CO2 reading

UNIT OFF

- 20 Test Procedure: Initiate unit shutdown via BAS.
- 21 Expected Response: SF's Stop
- 22 Expected Response: Any Interlocked EF's Stop. (Record Values)
- 23 Expected Response: OA Damper closes.
- 24 Expected Response: BAS updates to indicate new conditions.

UNIT ON

- 25 Test Procedure: Initiate unit start-up via BAS.

- 26 Expected Response: OA Damper opens
- 27 Expected Response: SF's start after adjustable time delay. (Record Values)
- 28 Expected Response: Any Interlocked EF's start. (Record Values)
- 29 Expected Response: DX cooling OR heating controls to DAT Setpoint (Record Values)
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SUPPLY FAN CONTROL

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- 36 Test Procedure: Simulate Building is unoccupied
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- 43 Expected Response: BAS Updates to indicate each condition
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- 58 Expected Response: BAS Updates to indicate each condition

DISCHARGE AIR CONTROL

- | | |
|----|--|
| 59 | Record: Outside air high limit Temperature -75F design value |
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| 70 | Expected Response: BAS Updates to indicate each condition |
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| 73 | Expected Response: BAS Updates to indicate each condition |

ALARMS

- | | |
|----|---|
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| 75 | Level 2 alarm produced when discharge air humidity is greater than 55%RH after time delay (record time delay) |
| 76 | Level 3 alarm produced when CO2 sensor reads less than 400 PPM or greater than 2,000 PPM after time delay (record time delay) |
| 77 | Expected Response: BAS Updates to indicate each condition |

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  EF-1

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN OPERATION

- 1 Command fan to run via BAS
- 2 Verify the fan is on.
- 3 Is the correct fan status displayed on the BAS?
- 4 Place the HOA switch in the off position.
- 5 Verify the fan is off.
- 6 Is the correct fan status displayed on the BAS?
- 7 Is the fan supplied with a backdraft damper?
- 8 Does the backdrat damper close when the fan is powered off?
- 9 Place the HOA switch in the auto position.

ALARM VERIFICATION

- 10 Verify the fan is on.
- 11 Fail power to exhaust fan.
- 12 Did the BAS received an alarm.
- 13 Restore power to the exhaust fan.

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  EF-2

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN OPERATION

- 1 Command fan to run via BAS
- 2 Verify the fan is on.
- 3 Is the correct fan status displayed on the BAS?
- 4 Place the HOA switch in the off position.
- 5 Verify the fan is off.
- 6 Is the correct fan status displayed on the BAS?
- 7 Is the fan supplied with a backdraft damper?
- 8 Does the backdrat damper close when the fan is powered off?
- 9 Place the HOA switch in the auto position.

ALARM VERIFICATION

- 10 Verify the fan is on.
- 11 Fail power to exhaust fan.
- 12 Did the BAS received an alarm.
- 13 Restore power to the exhaust fan.



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-3

Attempts Most Recent

Attempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN OPERATION

- 1 Command fan to run via BAS
- 2 Verify the fan is on.
- 3 Is the correct fan status displayed on the BAS?
- 4 Place the HOA switch in the off position.
- 5 Verify the fan is off.
- 6 Is the correct fan status displayed on the BAS?
- 7 Is the fan supplied with a backdraft damper?
- 8 Does the backdrat damper close when the fan is powered off?
- 9 Place the HOA switch in the auto position.

ALARM VERIFICATION

- 10 Verify the fan is on.
- 11 Fail power to exhaust fan.
- 12 Did the BAS received an alarm.
- 13 Restore power to the exhaust fan.



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-4

Attempts Most Recent

Attempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN OPERATION

- 1 Command fan to run via BAS
- 2 Verify the fan is on.
- 3 Is the correct fan status displayed on the BAS?
- 4 Place the HOA switch in the off position.
- 5 Verify the fan is off.
- 6 Is the correct fan status displayed on the BAS?
- 7 Is the fan supplied with a backdraft damper?
- 8 Does the backdrat damper close when the fan is powered off?
- 9 Place the HOA switch in the auto position.

ALARM VERIFICATION

- 10 Verify the fan is on.
- 11 Fail power to exhaust fan.
- 12 Did the BAS received an alarm.
- 13 Restore power to the exhaust fan.

#10 EF-ISO-1

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-ISO-1

Attempts Most Recent

Attempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN OPERATION

- 1 Command fan to run via BAS
- 2 Verify the fan is on.
- 3 Is the correct fan status displayed on the BAS?
- 4 Place the HOA switch in the off position.
- 5 Verify the fan is off.
- 6 Is the correct fan status displayed on the BAS?
- 7 Is the fan supplied with a backdraft damper?
- 8 Does the backdrat damper close when the fan is powered off?
- 9 Place the HOA switch in the auto position.

ALARM VERIFICATION

- 10 Verify the fan is on.
- 11 Fail power to exhaust fan.
- 12 Did the BAS received an alarm.
- 13 Restore power to the exhaust fan.



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset EF-ISO-2

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

EXHAUST FAN OPERATION

- 1 Command fan to run via BAS
- 2 Verify the fan is on.
- 3 Is the correct fan status displayed on the BAS?
- 4 Place the HOA switch in the off position.
- 5 Verify the fan is off.
- 6 Is the correct fan status displayed on the BAS?
- 7 Is the fan supplied with a backdraft damper?
- 8 Does the backdrat damper close when the fan is powered off?
- 9 Place the HOA switch in the auto position.



ALARM VERIFICATION

- 10 Verify the fan is on.
- 11 Fail power to exhaust fan.
- 12 Did the BAS received an alarm.
- 13 Restore power to the exhaust fan.

#117 Equipment Storage 229 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Equipment Storage 229 -
 Wall Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VACANCY



- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#118 Exam 1 201 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 1 201 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#66 Exam 1 201 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 1 201 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#119 Exam 2 202 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 2 202 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#67 Exam 2 202 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 2 202 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#120 Exam 3 203 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 3 203 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#68 Exam 3 203 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 3 203 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#121 Exam 4 204 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 4 204 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#69 Exam 4 204 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 4 204 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#122 Exam 5 205 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 5 205 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#70 Exam 5 205 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 5 205 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#123 Exam 6 206 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 6 206 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#71 Exam 6 206 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 6 206 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#124 Exam 7 212 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 7 212 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#72 Exam 7 212 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Exam 7 212 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#12 Exterior Lighting

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Exterior Lighting


Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

EXTERIOR LIGHTING

1	Test Procedure: Simulate that the photocell is exposed to light and the schedule is not calling for exterior lighting to engage
2	Expected Response: Exterior lighting is disengaged
3	Test Procedure: Simulate that the photocell is exposed to light and the schedule is calling for exterior lighting to engage
4	Expected Response: Exterior lighting remains disengaged
5	Test Procedure: Simulate that the photocell is exposed to dark and the schedule is calling for exterior lighting to engage
6	Expected Response: Exterior lighting engages
7	Test Procedure: Trip override switch for Pole lights
8	Expected Response: Pole lights are disengaged
9	Test Procedure: Trip override switch for bollard lights
10	Expected Response: Bollard lights are disengaged
11	Test Procedure: Trip override switch for canopy lights
12	Expected Response: Canopy lights are disengaged
13	Test Procedure: Trip override switch for wall pack lights
14	Expected Response: wall pack lights are disengaged

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-1**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED

0% Yes | 0% No | 0% N/A

Asset FCU 1-2

Attempts Most Recent

Attempt No. 1

NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
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SPLIT SYSTEM COOL OFF - HEATING MODE

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ALARMS

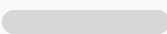
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- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-3**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
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SPLIT SYSTEM COOL OFF - HEATING MODE

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- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-4**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-5

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
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FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
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- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

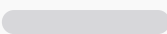
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- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-6**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
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FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
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- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-7

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
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FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
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- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

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- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-8**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
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- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
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- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-9

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
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FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
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- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

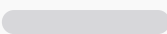
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- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

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- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-10**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
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FAN OPERATION

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ALARMS

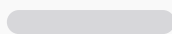
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GRAPHICS

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- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-11**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
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FAN OPERATION

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- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

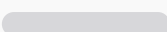
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- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

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- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-12**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

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- 9 Expected Response: Unit engages fan continuously
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- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

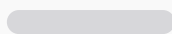
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- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-13**Attempts** Most RecentAttempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
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FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

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- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 1-14

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
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FAN OPERATION

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ALARMS


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- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-15**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
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FAN OPERATION

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ALARMS

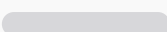
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- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 1-16**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

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FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
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ALARMS

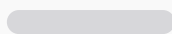
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GRAPHICS

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- 20 Record: Space Temperature
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- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-1**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

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ALARMS

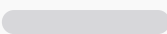
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- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-2**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
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FAN OPERATION

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ALARMS


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- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-3**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

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- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

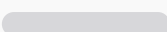
- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-4**Attempts** Most RecentAttempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

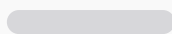
- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-5**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-6

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-7**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-8

Attempts Most RecentAttempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

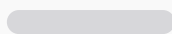
- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-9**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-10**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-11A

Attempts Most RecentAttempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-11B**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-12

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-13**Attempts** Most RecentAttempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 2-14**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 2-15

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-1A

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

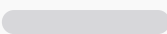
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- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-1B**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
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- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
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ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
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- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-2**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
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- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
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ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-3**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

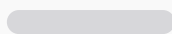
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- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-4**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-5**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset FCU 3-6

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-7**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

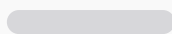
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- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-8**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

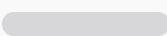
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- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-9**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-10**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS

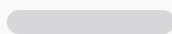
- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-11**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
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- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-12**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
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- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-13**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
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ALARMS

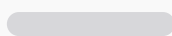
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GRAPHICS

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- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-14**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
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- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
- 9 Expected Response: Unit engages fan continuously
- 10 Test Procedure: Adjust zone to be in "Unoccupied Mode"
- 11 Expected Response: Unit disengages fan
- 12 Test Procedure: While in "Unoccupied Mode" - change setpoint to engage unit into cooling or heating.
- 13 Expected Response: Unit engages fan to satisfy call

ALARMS


- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
- 15 Level "2" alarm on common VRF alarm generated at any outdoorunit
- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status

24 Record: Common Alarm Status

25 Record: Fan status

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  FCU 3-15**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages/stays engaged

SPLIT SYSTEM COOL OFF - HEATING MODE

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode;
- 6 Expected Response: Supply fan remains engaged
- 7 After time delay unit engages to provide warm air to space.

FAN OPERATION

- 8 Test Procedure: Adjust zone to be in "Occupied Mode"
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ALARMS

- 14 Level "2" alarm on common VRF alarm generated at any indoor/rooftop unit
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- 16 Level "2" alarm when BAS loses comm with the VRF communication manager

GRAPHICS

- 17 VRF unit provided with graphic similar to non-VRF components with different color scheme
- 18 Record: VRF status (on/off) provided
- 19 Record: Mode of operation
- 20 Record: Space Temperature
- 21 Record: Space Temperature Setpoint
- 22 Record: Occupied/Unoccupied status
- 23 Record: Timed override occupancy status



24 Record: Common Alarm Status

25 Record: Fan status

#125 Financial Office 311 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Financial Office 311 -
 Ceiling Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#126 Financial Screen 312 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Financial Screen 312 -
 Ceiling Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#13 Fire Alarm System

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Fire Alarm System

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

FIRE ALARM SYSTEM

- 1 Upload: Fire Marshal acceptance letter
- 2 Test Procedure: Artificially trip - Smoke detector in Vestibule 100
- 3 Expected response: Fire alarm engages
- 4 Test Procedure: Artificially trip - Smoke detector in Electrical 152
- 5 Expected response: Fire alarm engages
- 6 Test Procedure: Trip pull station
- 7 Expected response: Fire alarm engages
- 8 Expected response: verify all horns/horn strobes engage

#127 Fire Riser 307 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Fire Riser 307 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VACANCY



- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#128 Flex 1 213 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 1 213 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#73 Flex 1 213 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 1 213 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#129 Flex 2 214 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 2 214 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#74 Flex 2 214 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 2 214 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER



- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#130 Flex 3 215 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 3 215 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#75 Flex 3 215 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Flex 3 215 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#154 Generator - Load Bank

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Generator

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.


PRE-REQUISITES BEFORE LOAD TESTING

- 1 Demonstration of the following requirements have been coordinated prior to scheduling load bank testing and complete/ready to verify:
- 2 Confirmation from installer that total engine run time is to be minimum of four hours, complying with NFPA 110.
- 3 Noise level test, to be performed during full load, see procedure below.
- 4 If applicable, motorized louvers automatically operate from generator engine start/stop signal.
- 5 If applicable, generator enclosure/room lights operate on both normal and emergency power.
- 6 If applicable, space heater operates.

GENERATOR LOAD TESTING

- 7 Verify primary power to all ATS's is available and devices are connected to Normal source.
- 8 Test Procedure: Disconnect Primary power to all ATS.
- 9 Test Procedure: Incrementally increase load on generator until 100% of generator capacity is achieved within two hours of run time. Incrementally load values and duration of steps is at the discretion of the manufacturers on-site representative.
- 10 Record: 15 minutes into test: Kilowatts
- 11 Record: 15 minutes into test: Amps
- 12 Record: 15 minutes into test: Voltage
- 13 Record: 15 minutes into test: Coolant Temperature
- 14 Record: 15 minutes into test: Ambient Temperature
- 15 Record: 15 minutes into test: Frequency
- 16 Record: 15 minutes into test: Oil Pressure
- 17 Record: 30 minutes into test: Kilowatts
- 18 Record: 30 minutes into test: Amps
- 19 Record: 30 minutes into test: Voltage
- 20 Record: 30 minutes into test: Coolant Temperature
- 21 Record: 30 minutes into test: Ambient Temperature
- 22 Record: 30 minutes into test: Frequency
- 23 Record: 30 minutes into test: Oil Pressure
- 24 Record: 45 minutes into test: Kilowatts
- 25 Record: 45 minutes into test: Amps

- 26 Record: 45 minutes into test: Voltage
 - 27 Record: 45 minutes into test: Coolant Temperature
 - 28 Record: 45 minutes into test: Ambient Temperature
 - 29 Record: 45 minutes into test: Frequency
 - 30 Record: 45 minutes into test: Oil Pressure
 - 31 Record: 45 minutes into test: Engine speed
 - 32 Test Procedure: Following successful load bank increments, test at 100% Load for the remaining time left, (minimum of 4 hours total.)
 - 33 Record: Kilowatts
 - 34 Record: Amps
 - 35 Record: Voltage
 - 36 Record: Coolant Temperature
 - 37 Record: Ambient temperature
 - 38 Record: Frequency
 - 39 Record: Oil Pressure
 - 40 Record: Engine speed
 - 41 Test Procedure: Noise level test, to be performed during full load. Test 10' from exhaust pipe noise levels.**
 - 42 Record: Noise level.
 - 43 Reset: Following successful total 4 hour run time, remove load bank and restore primary to each ATS.
 - 44 Record: Generator cool down time period.
 - 45 Record: Generator shutdown time period.
 - 46 Record: Engine runtime.
-

NOT STARTED  0% Yes | 0% No | 0% N/AAsset  Generator**Attempts** Most RecentAttempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

NORMAL MODE

- 1 VERIFY: All ATS are in the normal position.
- 2 VERIFY: All ATS fed from the normal (utility) power source.
- 3 VERIFY: The emergency power system is in Normal (Utility) mode.

EMERGENCY MODE (ENTERING)

- 4 Test Procedure: Open Main switches serving emergency loads. To be coordinated with installing contractor, simultaneous operation.
- 5 Expected Response: ATS sends the generator a run request.
- 6 Expected Response: Emergency generators start automatically.
- 7 Expected Response: Priority 1 (Life Safety) load is powered in under 10 seconds.
- 8 Expected Response: Non Priority 1 loads are powered when permissive circuit opens.
- 9 Expected Response: All listed equipment is operating properly on emergency power:

EMERGENCY MODE (EXITING)

- 10 Test Procedure: Close Main Breakers serving emergency power loads, making Normal source available.
- 11 Expected Response: ATS senses utility source is within acceptable operational tolerances.
- 12 Expected Response: ATS transfers back to utility power, removing the run request to the generators.
- 13 Expected Response: When the ATS has retransferred to the utility, all generator circuit breakers are OPENED.
- 14 Expected Response: Generators are allowed to run for the programmed cool-down time.
- 15 Expected Response: All listed equipment returns to normal operation after restoration of utility power.



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Generator

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

CRANK CYCLE TEST

- 1 Test Procedure: Utilize any method recommended by manufacturer to prevent the prime mover from running.
- 2 Test Procedure: Put the control switch into "run" to cause the prime mover to crank.
- 3 Expected Response: Starting battery pack is capable of maintaining cranking speed for 75 second cycle per NFPA 110 (15 sec crank, 15 sec rest, 15 sec crank, 15 sec rest, 15 sec crank).
- 4 Record: Battery Voltage at conclusion of test.

GENERATOR CONTROL PANEL: VERIFY THE PROPER OPERATION OF EACH FUNCTION:

- 5 3-position Selector switch (run/off/auto)
- 6 Local emergency stop button
- 7 Push-button reset switch
- 8 Voltage adjustment potentiometer
- 9 Self-diagnostic capabilities with a readout on a digital display panel
- 10 Lamp test switch
- 11 Panel illumination lights with on/off switch
- 12 Contacts for local and remote common alarm
- 13 Verify activation of alarm horn and indicating LED for each alarm and shutdown.

GENERATOR CONTROL PANEL: VERIFY THE PROPER OPERATION OF EACH SHUTDOWN, ALARM AND PRE-ALARM:

- 14 Overcrank shutdown - red
- 15 Low coolant temperature alarm - red
- 16 High water temperature pre-alarm - amber
- 17 High water temperature shutdown - red
- 18 Low oil pressure pre-alarm - amber
- 19 low oil pressure shutdown - red
- 20 Overspeed shutdown - red
- 21 Low fuel main tank
- 22 Low coolant level
- 23 EPS supplying load
- 24 Controls not in auto

- 25 High battery voltage
- 26 Low cranking voltage
- 27 Low battery voltage
- 28 Battery charger failure alarm

GENERATOR CONTROL PANEL: VERIFY THE PROPER OPERATION OF EACH METER AND GAUGE:

- 29 Voltmeter
- 30 Ammeter
- 31 Frequency meter
- 32 Power factor
- 33 KVAR
- 34 KWH
- 35 Battery charging voltmeter
- 36 Coolant temperature gauge
- 37 Oil pressure gauge
- 38 Running time meter
- 39 Engine RPM

GENERATOR REMOTE ANNUNCIATOR PANEL VERIFY ACTIVATION OF ALARM HORN AND INDICATING LED FOR EACH ALARM AND SHUTDOWN:

- 40 Overcrank shutdown
- 41 Low coolant temperature alarm
- 42 High water temperature pre-alarm
- 43 High water temperature shutdown
- 44 Low oil pressure pre-alarm
- 45 Low oil pressure shutdown
- 46 Overspeed shutdown
- 47 Low fuel main tank
- 48 Low coolant level
- 49 Controls not in auto
- 50 Lamp test switch
- 51 Procedure: Activate remote emergency stop pushbutton
- 52 Verify: Generator shuts down immediately

ALARM AND SHUTDOWN SETTINGS

- 53 Procedure: At conclusion of alarm and shutdown testing, document as left set points for each:
- 54 Record overcrank shutdown (sec):
- 55 Record low coolant temperature alarm:
- 56 Record high water temperature alarm:
- 57 Record low oil pressure alarm:

58 Record low oil pressure shutdown:

59 Record over speed shutdown:

60 Record low coolant level:

61 Record high battery voltage:

62 Record low battery voltage:

63 Expected Response: Alarm indicating condition is sent to BAS.

GENERATOR CONTROL WIRING TEST

64 Verify control conductors installed between the transfer equipment and the emergency generator shall be kept entirely independent of all other wiring. (NEC 700.10(D)(3))

65 Disable or remove start signal wiring from transfer switch to generator.

66 Generator initiates audible and visual alarm at local and remote annunciators. (NEC 700.10(D)(3))

67 Generator starts up. (NEC 700.10(D)(3))



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset HK-1

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

POINT VERIFICATION

- 1 Record: VRF water heater status
- 2 Record: Entering Domestic water temperature
- 3 Record: Leaving Domestic water temperature

SYSTEM OPERATION

- 4 Test Procedure: Simulate all spaces are in cooling with each indoor unit at a 60F setpoint
- 5 Test Procedure: Open all sink taps to full domestic hot water
- 6 Expected Response: VRF water heater should have ample heat to reject to domestic water loop and should engage
- 7 Expected Response: BAS is updated to indicate VRF domestic heater engaged
- 8 Test Procedure: Directly after cooling simulate all spaces are in heating with each indoor unit at a 90F setpoint
- 9 Test Procedure: Open all sink taps to full domestic hot water
- 10 Expected Response: VRF water heater should have no heat to reject to domestic water loop and should disengage
- 11 Expected Response: BAS is updated to indicate VRF domestic heater engaged

ALARM


- 12 Leve 2 alarm produced if unit goes offline

#131 HSKP 302 - Wall

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  HSKP 302 - Wall Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#93 HWWS Station 415 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  HWWS Station 415 -
 Ceiling Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#1 Info 101 - Daylight

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Info 101 - Daylight

Attempts Most Recent

Attempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

SPACE DAYLIGHTING CONTROL

- 1 Space lighting fixtures increase input when space photocell indicates low ambient lighting conditions (Cover sensors with masking tape)
- 2 Space lighting fixtures decrease input when space photocell indicates higher ambient lighting conditions (remove masking tape)

#14 Irrigation System

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Irrigation System

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.

IRRIGATION SYSTEM



- 1 Test Procedure: Disengage irrigation system via time of day schedule
- 2 Expected Response: Sprinklers on site are disengaged
- 3 Test Procedure: Engage irrigation system via time of day schedule
- 4 Expected Response: Sprinklers on site engage
- 5 Test Procedure: While sprinklers are engaged in the irrigation system via time of day schedule - trip rain sensor to indicate rainfall
- 6 Expected Response: Sprinklers on site disengage
- 7 Record: Rain sensor setpoint

#94 Lab 104 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Lab 104 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#95 Lab 423 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Lab 423 - Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#132 MDF/Security 303 -

Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED 0% Yes | 0% No | 0% N/A

Asset  MDF/Security 303 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 NOT STARTED

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#133 Med Gas 305 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Med Gas 305 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VACANCY



- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#96 Mens 107 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Mens 107 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#97 Mens 107 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00



NOT STARTED 0% Yes | 0% No | 0% N/A

Asset Mens 107 - Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED**

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#134 Mothers Rm 313 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Mothers Rm 313 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#76 Mothers Rm 313 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Mothers Rm 313 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#15 MS-1A

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  MS-1A

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

SPLIT SYSTEM COOL ON

- 1 Test Procedure: Adjust the room-mounted thermostat setting to slightly above the actual room temperature
- 2 Expected Response: Unit engages into cooling mode; compressor modulates
- 3 Expected Response: Supply fan engages



SPLIT SYSTEM COOL OFF

- 4 Test Procedure: Adjust the room-mounted thermostat setting to slightly below the actual room temperature
- 5 Expected Response: Unit disengages cooling mode; compressor off
- 6 Expected Response: Supply fan remains engaged
- 7 Thermostat to BAS installed in space
- 8 Level 3 alarm if BAS thermostat reads 80F(adj) for 5 minutes or greater

#135 Multi-Function 110 Left - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Multi-Function 110 Left -
 Ceiling Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#136 Multi-Function 110 Right - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Multi-Function 110 Right -
 Ceiling Vacancy

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#137 Panorex 405 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Panorex 405 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#98 Pat Toilet 419 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Pat Toilet 419 -
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#138 Ped 1 216 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Ped 1 216 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#77 Ped 1 216 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Ped 1 216 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#139 Ped 2 217 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Ped 2 217 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#78 Ped 2 217 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Ped 2 217 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#140 Procedure 207 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Procedure 207 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#79 Procedure 207 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Procedure 207 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#80 PVT Adult 407 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  PVT Adult 407 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#81 PVT Adult 408 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  PVT Adult 408 - Dimmer
 Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#141 Soiled Holding 228 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Soiled Holding 228 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VACANCY


- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#99 Spec Tlt 222 -

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Spec Tlt 222 - Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#142 Speciality Exam 208 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Speciality Exam 208 -
 Ceiling Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#82 Speciality Exam 208 - Dimmer Switch

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Speciality Exam 208 -
 Dimmer Switch

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.


WALL DIMMER

- 1 Space dimmer switch engages lights on/off and lowers lighting levels

#100 Staff Tlt 233 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Staff Tlt 233 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.


OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#101 Staff Tlt 233 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Staff Tlt 233 - Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#102 Staff Toilet 422 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Staff Toilet 422 -
 Occupancy

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#103 Staff Toilet 501 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Staff Toilet 501 -
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#143 Sterilization 421 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Sterilization 421 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#144 Storage 111 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Storage 111 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#145 Storage 224 - Ceiling Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Storage 224 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#146 Storage 406 - Wall



Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED



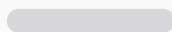
0% Yes | 0% No | 0% N/A

Asset  Storage 406 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1

NOT STARTED



Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#147 Touchdown 1 220 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Touchdown 1 220 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#148 Touchdown 4 401 - Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Touchdown 4 401 - Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#149 Touchdown 5 402- Wall Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Touchdown 5 402- Wall
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#150 VAC 306 - Wall

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  VAC 306 - Wall Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#104 Vaccine 219 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Vaccine 219 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#105 Vestibule 100 - Ceiling

Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Vestibule 100 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 NOT STARTED 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY



- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#151 Vitals 223 - Ceiling

Vacancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Vitals 223 - Ceiling
 Vacancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



VACANCY

- 1 Space lighting fixtures engage manually via switch
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#106 Waiting 102 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Waiting 102 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.



OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#107 Womens 106 - Ceiling Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Womens 106 - Ceiling
 Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.


OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage

#108 Womens 106 - Occupancy

Gresham Smith | Central Health: Del Valle | 45205.00

NOT STARTED  0% Yes | 0% No | 0% N/A

Asset  Womens 106 - Occupancy

Attempts Most Recent

Attempt No. 1 **NOT STARTED** 

Status set by Justin Hethcote on 8/15/2021.

OCCUPANCY

- 1 Space lighting fixtures engage automatically after entering space
- 2 Space lighting fixtures disengage automatically after leaving space - Record time to disengage



Gresham Smith

