STATE LET BUILDING CONTRACT

NEW MCKINNEY AEM FACILITY

LOCATION:	**2205 TX 5**
CITY/ST/ZIP:	**MCKINNEY, TEXAS 75069**
COUNTY:	**COLLIN**
DISTRICT:	**DALLAS**
SITE NO:	**189799**
BLDG NO:	**188196, 188197**
PROJECT ID:	**18-470420012-REBID**
ESTIMATED COST:	**$10,100,000.00**
BID GUARANTY or BID BOND:	**$100,000.00**
PRE-BID DATE, TIME:	**MAY 11, 2021 @ 1:00 PM CST**
PRE-BID LOCATION:	**See Instructions to Bidders page**
BID DATE, TIME via WebEx:	**JUNE 1, 2021 @ 1:00 PM CST**
BIDS MUST BE RECEIVED BY:	**NOON (12:00 PM CST) FOR 1:00 PM CST READING**
BID LOCATION:	**TxDOT STATE HEADQUARTERS**
BID ADDRESS:	**150 EAST RIVERSIDE DRIVE, 4N, AUSTIN, TEXAS 78704**

Texas Department of Transportation

SUPPORT SERVICES DIVISION (SSD)
FACILITIES PLANNING AND MANAGEMENT

RETURN COMPLETED PROPOSAL PACKAGE TO:

150 RIVERSIDE DR., 4th FLOOR-NORTH TOWER, AUSTIN, TX 78704
ATTN: Laura Mullins

PROPOSAL PACKAGES DELIVERED AFTER NOON (12:00 pm CST) ON THE OFFICIAL LETTING DATE, RECEIVED INCOMPLETE OR WITH MISSING DOCUMENTS WILL BE REJECTED

TITLE PAGE FOR STATE LET BUILDING CONTRACT (SLBC)

TITLE & DESCRIPTION OF THE WORK:

NEW MCKINNEY AEM FACILITY

LOCATION:	2205 TX 5
CITY/ST:	MCKINNEY, TEXAS 75069
COUNTY:	COLLIN
DISTRICT:	DALLAS
SITE NO:	189799
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BID DATE, TIME:	JUNE 1, 2021 @ 1:00 PM CST
BID LOCATION:	TxDOT STATE HEADQUARTERS
BID ADDRESS:	150 EAST RIVERSIDE DRIVE, 4N, AUSTIN, TEXAS 78704

NAME & ADDRESS OF THE OWNER:

TEXAS DEPARTMENT OF TRANSPORTATION
125 E. 11TH STREET
AUSTIN, TEXAS 78701-2483

NAME OF TxDOT PROJECT DEVELOPMENT MANAGER:

PROJECT MANAGER:	STEVE MEYERS
DIVISION:	38-SSD (SUPPORT SERVICES DIVISION)
ADDRESS:	125 E 11TH ST (RA 150, 4N), AUSTIN, TX 78701
PHONE NUMBER:	(512) 431-8210
E-MAIL:	Steve.Meyers@txdot.gov

NAME OF TxDOT CONSTRUCTION PROJECT MANAGER:

PROJECT MANAGER:	SHARON WARBROUCK
DIVISION:	38-SSD (SUPPORT SERVICES DIVISION)
ADDRESS:	125 E 11TH ST (RA 150, 4N), AUSTIN, TX 78701
PHONE NUMBER:	(817) 889-7973
E-MAIL:	Sharon.Warbrouck@txdot.gov

NAME & ADDRESS OF THE ARCHITECT/ENGINEER:

PROJECT MANAGER:	JACOBS ENGINEERING GROUP, INC.
CONTACT NAME:	STEVEN TREMMEL, R.A.
ADDRESS:	1999 BRYAN ST., SUITE 1200, DALLAS, TEXAS 75231
PHONE NUMBER:	(214) 563-8524
E-MAIL:	Steven.Tremmel@jacobs.com

SLBC PROPOSAL DOCUMENT QUICK CHECK LIST

THIS LIST IS PROVIDED AS A REFERENCE TO BIDDING CONTRACTORS OF REQUIRED DOCUMENTS.
THESE FORMS **MUST BE INCLUDED** AS PART OF YOUR PROPOSAL.
MISSING OR INCOMPLETE DOCUMENTS WILL CAUSE YOUR PROPOSAL TO BE REJECTED.

- ☐ COVER SHEET
- ☐ TITLE PAGE
- ☐ CHECK LIST
- ☐ INDEX OF PROPOSAL
- ☐ PRIORITY INVOICE PROCESSING FORM (must be filled out even if you choose not to participate)
- ☐ ADDENDUM ACKNOWLEDGEMENT (any & all addendums MUST be acknowledged)
- ☐ BID BOND (must be TxDOT form with original signatures & impressed surety seal)
- ☐ RETURN BID GUARANTY CHECK FORM
- ☐ VCSLC INFORMATION PAGE
- ☐ LUMP SUM BID SHEET
- ☐ ALLOWANCES (if applicable)
- ☐ AUTHORIZED SIGNATURES
- ☐ PROPOSAL TO THE TEXAS TRANSPORTATION COMMISSION
  (Dollar amounts must be documented in **PEN**. Changes made to the original dollar amount MUST be lined through and initialed in ink, NO WHITE OUT)
- ☐ E-VERIFY MEMORANDUM OF UNDERSTANDING FOR EMPLOYERS (required)
- ☐ HUB SUBCONTRACTING PLAN (required)
- ☐ SEALED BID ENVELOPE COVER SHEET (affix to front of sealed envelope)

DOCUMENTS SHALL BE STAPLED OR ATTACHED WITH A BINDER CLIP ONLY.
DO NOT BIND IN ANY WAY.
NO NOTEBOOKS, PRESENTATION FOLDERS, SPIRAL OR OTHERWISE.

Bids are required to be submitted by Noon (12:00 PM CST) on the Letting Date.
The bid reading will begin at 1:00 PM CST.

Texas Department of Transportation

STATE LET BUILDING CONTRACT

SUPPORT SERVICES DIVISION
FACILITIES PLANNING & MANAGEMENT

INDEX OF PROPOSAL

Texas Department of Transportation

EARLY PAYMENT PROGRAM

TxDOT has partnered with Oxygen Finance Americas, Inc. to offer all bidders and active TxDOT vendors the opportunity to enroll in the Early Payment Program (EPP). The EPP gives vendors more flexibility and control of their business and finances. Benefits include:

- Electronic invoice submissions sent to one email address for all TxDOT divisions
- Invoices are time-stamped upon receipt
- Rejection notices are usually sent within 1 business day with instructions on how to revise & resubmit for payment
- Payments are typically made within 10 business days*, providing you cash sooner
- Monthly remittance statements are provided to EPP vendors for reconciliation
- Live supplier support specialists are available to help EPP vendors through all stages of invoicing and payments

Please fill out the information below and return this form with your completed response

Company: _____ Tax ID/EIN: _____

Contact Name: _____ Title: _____

Address: _____

Email: _____ Phone: _____

Billing Contact: _____ Title: _____

Address: _____

Email: _____ Phone: _____

OPTIONS (Please check one):

☐ Yes, I would like to enroll in the EPP with the following terms for all future invoices:_____ % / 10 Days / Net 30 **
Texas State Agencies are allowed to make early payments to vendors, but are required to take a discount in return. (Texas Government Code, Chapter 2155.382). TxDOT allows EPP vendors to determine the invoice discount rate (%) that best suits their business needs.

- I confirm that I am an authorized representative of this company and that if TxDOT pays any Invoiced Debt owed to the aforementioned company under or in connection with any Contract prior to the date by which such payment would otherwise be required to be made under the terms of that Contract, TxDOT shall be entitled to deduct and retain from that Invoiced Debt, for its own benefit, an Early Payment Discount which it will deduct and retain from that Invoiced Debt. These terms will apply to all invoices unpaid as of the date of signature as printed on this form. Early payment discounts are dynamically calculated, with a target payment date of 10 days from the date of invoice acceptance. The final discount taken is proportionate to the number of days the payment is accelerated. A discount is taken ONLY if payment is made before 30 days from the date of invoice acceptance.
- I confirm that I am an authorized representative of this company and agree to the Oxygen Network Supplier Terms of Use found at http://ftp.dot.state.tx.us/pub/txdot-info/fin/early-pmt/oxygen-network-terms.pdf

☐ I'm interested in the EPP, but would like a supplier support specialist to call me at this number _____

☐ I am already enrolled in the EPP

☐ No, I am not interested at this time

_____ _____ _____
Printed Name Signature Date

*Please note: Direct deposits post 1-3 business days after the payment date and paper checks could take up to 5 business days to receive
**TxDOT reserves the right to approve or reject any proposed rates.
To learn more about the program and its benefits, visit www.txdot.gov/business/vendors/epp.html
To speak with a supplier support specialist, call 866-515-3860 or email at earlypay@txdot.gov
THIS PAGE SHOULD BE RETURNED WITH YOUR COMPLETED RESPONSE

DISTRICT: DALLAS

COUNTY: COLLIN

LOCATION: 2205 TX 5

PROJECT ID: 18-470420012-REBID

ADDENDUM ACKNOWLEDGMENT
For
STATE LET BUILDING CONTRACT (SLBC)

Each bidder is required to acknowledge receipt of an addendum issued for a specific project. This page is provided for the purpose of acknowledging an addendum.

FAILURE TO ACKNOWLEDGE RECEIPT OF AN ADDENDUM WILL RESULT IN THE BID NOT BEING READ.

In order to properly acknowledge an addendum, place a mark in the box next to the respective addendum.

ADDENDUM NO. 1 ☐

ADDENDUM NO. 2 ☐

ADDENDUM NO. 3 ☐

ADDENDUM NO. 4 ☐

In addition, the bidder by affixing their signature to the signature page of the proposal is acknowledging that they have taken the addendum(s) into consideration when preparing their bid and that the information contained in the addendum will be included in the contract, if awarded by the Commission or other designees.

TEXAS DEPARTMENT OF TRANSPORTATION
BID BOND

KNOW ALL PERSONS BY THESE PRESENTS,

That we, (Contractor Name) _____

Hereinafter called the Principal, and (Surety Name) _____

a corporation or firm duly authorized to transact surety business in the State of Texas, hereinafter called the Surety, are held and firmly bound unto the Texas Department of Transportation, hereinafter called the Obligee, in the sum of not less than two percent (2%) of the department's engineer's estimate, rounded to the nearest one thousand dollars, not to exceed one hundred thousand dollars ($100,000) as a proposal guaranty (amount displayed on the cover of the proposal), the payment of which sum will and truly be made, the said Principal and the said Surety, bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents .

WHEREAS, the principal has submitted a bid for the following project identified as:

DISTRICT: DALLAS

COUNTY: COLLIN

LOCATION: 2205 TX 5

PROJECT ID: 18-470420012-REBID

NOW, THEREFORE, if the Obligee shall award the Contract to the Principal and the Principal shall enter into the Contract in writing with the Obligee in accordance with the terms of such bid, then this bond shall be null and void. If in the event of failure of the Principal to execute such Contract in accordance with the terms of such bid, this bond shall become the property of the Obligee, without recourse of the Principal and/or Surety, not as a penalty but as liquidated damages.

Signed this _____ Day of _____ , 20 _____ .

By _____
(Contractor/Principal Name)

_____
(Signature and Title of Authorized Signatory for Contractor/Principal)

*By: _____
(Surety Name)

_____ _____
(Signature of Attorney-in-Fact) Printed Name

***Attach Power of Attorney (Surety) for Attorney-in-Fact**

Impressed Surety Seal Only

RETURN BID GUARANTY CHECK FORM

(CHECK NOT REQUIRED IF SUBMITTING A BID BOND)

IMPORTANT

The space provided for the return address must be completed to facilitate the return of your bidder's check. Care must be taken to provide a legible, accurate, and complete return address, including zip code. A copy of this sheet should be used for each different return address.

NOTE

Successful bidder will receive their guaranty check with the executed contract.

DISTRICT: DALLAS

COUNTY: COLLIN

LOCATION: 2205 TX 5

PROJECT ID: 18-470420012-REBID

IMPORTANT PLEASE RETURN THIS SHEET IN ITS ENTIRETY

Please acknowledge receipt of this check(s) at your earliest convenience by signing below, in ink, and returning this acknowledgment.

Check Received By: _____ Date: _____

Title:

For (Contractor's Name): _____

STATE LET BUILDING CONTRACT (SLBC)

NAME _____

STREET ADDRESS _____

CITY, ST, ZIP _____

DISTRICT:	DALLAS
COUNTY:	COLLIN
LOCATION:	2205 TX 5
PROJECT ID:	18-470420012-REBID

STATE LET BUILDING CONTRACT (SLBC)

WORK CONSISTING OF:	**NEW MCKINNEY AEM FACILITY**		
LOCATED AT:	2205 TX 5		
City/State:	MCKINNEY, TEXAS 75069	Site Number:	189799
County:	COLLIN	Building Number:	188196, 188197

Bids for the above work will be opened and read:	**JUNE 1, 2021 @ 1:00 PM CST**		
Bids must be received by NOON (12:00 PM CST) on the opening date at the following location: TxDOT STATE HEADQUARTERS 150 EAST RIVERSIDE DRIVE, 4N, AUSTIN, TEXAS 78704 (No other time or location is acceptable for the receipt of this bid)			
Attention:	**Laura Mullins**	**Phone:**	**(512) 416-2458**

(Multiple projects could be scheduled at the same time – allow additional time for bids to be opened and read.)

Questions and requests for payment should be referred to the Owner's Representative in charge of all Work for this contract as follows:

PROJECT DEVELOPMENT PHASE	
Project Manager:	STEVE MEYERS
PD PM Address:	125 E 11TH ST (RA 150, 4N), AUSTIN, TX 78701
PD PM Phone No:	(512) 431-8210
PD PM Email:	Steve.Meyers@txdot.gov
CONSTRUCTION PHASE	
Project Manager:	SHARON WARBROUCK
CPM Address:	125 E 11TH ST (RA 150, 4N), AUSTIN, TX 78701
CPM Phone No:	(817) 889-7973
CPM Email:	Sharon.Warbrouck@txdot.gov

Estimated Cost of Work :	$10,100,000.00
Proposal Guaranty Check or Bid Bond:	$100,000.00

Pre-Bid Conference:	MAY 11, 2021 @ 1:00 PM CST
Pre-Bid On-Site Location:	2205 TX 5, MCKINNEY, TEXAS 75069
Pre-Bid Virtual Location:	N/A
Pre-Bid Virtual Access Code/Password:	N/A / N/A

Consultant:	JACOBS ENGINEERING GROUP, INC.
Contact Name:	STEVEN TREMMEL, R.A.
Address:	1999 BRYAN ST., SUITE 1200, DALLAS, TEXAS 75231
Phone No:	(214) 563-8524
Email:	Steven.Tremmel@jacobs.com

HUB Subcontracting Plan [XXX] Required [ ] NOT Required

A HUB SUB-CONTRACTING PLAN (HSP) IS DUE WITH THE BID PROPOSAL. PROPOSALS SUBMITTED WITH INCOMPLETE OR MISSING HSP DOCUMENTS WILL BE REJECTED. THE HSP SHALL BECOME PART OF THE BINDING CONTRACT WHEN FULLY EXECUTED BY BOTH PARTIES. SEE THE "HISTORICALLY UNDERUTILIZED BUSINESS PARTICIPATION OVERVIEW" IN THE STANDARD CONDITIONS FOR SPECIFIC HSP COMPLETION INSTRUCTIONS.

LUMP SUM BID SHEET

The undersigned, as bidder, certifies that he/she has carefully examined the form of contract, instructions to bidders, addenda (if issued), profiles, grades, specifications and the plans therein referred to, and has carefully examined the locations, existing conditions and dimensions; classes of materials and/or equipment of the proposed Work; and agrees to provide all the necessary machinery, labor, trades, tools, apparatus, and other means of construction, and will do all the Work and furnish all the materials called for in the contract and specifications in the manner prescribed therein and according to the requirements of the Architect/Engineer as herein set forth.

It is understood that the quantities of Work to be done and materials to be furnished may be increased or diminished as may be considered necessary, in the opinion of the Project Manager, to complete the Work fully as planned and contemplated, and that all quantities of Work, whether increased or decreased, are to be performed at the prices agreed upon or as provided for in the specifications.

It is further understood that the Work is to be completed in full in 450 calendar days.

Accompanying this proposal is a "Proposal Guaranty" check or a "Bid Bond" made payable to the Texas Transportation Commission in the following amount:

ONE HUNDRED THOUSAND DOLLARS

Bid amount must be filled out in ink. Fill out bid forms in this proposal, and return all bid documents as your proposal.

BID ITEM NUMBER 1: For the entire project described, **including allowances**, in this STATE LET BUILDING CONTRACT, specifications, attachments, and project drawings, including addenda – (if issued)

LUMP SUM BID FOR **BID ITEM NUMBER 1 (including allowances if applicable):**
(Print Numbers Carefully in Ink – one number per box. Line through and initial any changes.)

$ | | , | | | | , | | | | . | |

No further Bid Items.

ONLY THE ABOVE LUMP SUM BID WILL BE READ PUBLICLY BY THE DEPARTMENT AT THE PUBLIC BID OPENING

updated March 5, 2021

AUTHORIZED SIGNATURE PAGE FOR STATE LET BUILDING CONTRACT (SLBC)

NEW MCKINNEY AEM FACILITY

LOCATION:	2205 TX 5
CITY/ST:	MCKINNEY, TEXAS 75069
COUNTY:	COLLIN
DISTRICT:	DALLAS
SITE NO:	189799
BLDG NO:	188196, 188197
PROJECT ID:	18-470420012-REBID
ESTIMATED COST:	$10,100,000.00
BID GUARANTY or BID BOND:	$100,000.00
PRE-BID DATE, TIME:	MAY 11, 2021 @ 1:00 PM CST
BID DATE, TIME:	JUNE 1, 2021 @ 1:00 PM CST
BID LOCATION:	TxDOT STATE HEADQUARTERS
BID ADDRESS:	150 EAST RIVERSIDE DRIVE, 4N, AUSTIN, TEXAS 78704

COMPANY NAME AND ADDRESS:

Please print CLEARLY the following information

COMPANY LEGAL NAME: _____

LEGAL ADDRESS: _____

PHONE NUMBER: _____

E-MAIL: _____

TAXPAYER ID NUMBER _____

AUTHORIZED SIGNATURES: ***PRINT TITLE:***

_____

_____

_____

_____

NOTICE OF STATE AUDIT AUTHORITY

The state auditor may conduct an audit or investigation of any entity receiving funds from the state directly under the contract or indirectly through a subcontract under the contract. Acceptance of funds directly under the contract or indirectly through a subcontract under this contract acts as acceptance of the authority of the state auditor, under the direction of the legislative audit committee, to conduct an audit or investigation in connection with those funds. An entity that is the subject of an audit or investigation must provide the state auditor with access to any information the state auditor considers relevant to the investigation or audit.

DISTRICT: DALLAS

COUNTY: COLLIN

LOCATION: 2205 TX 5

PROJECT ID: 18-470420012-REBID

PROPOSAL TO THE TEXAS TRANSPORTATION COMMISSION

NEW MCKINNEY AEM FACILITY

2205 TX 5 , MCKINNEY, TEXAS 75069

The quantities of work and materials may be increased or decreased as considered necessary to complete the work as planned and contemplated.

This project to be completed in 450 calendar days and will be accepted when fully completed and finished to the satisfaction of the Executive Director or designee.

Accompanying this proposal is a Proposal Guaranty in the form of a Cashier's Check, Teller's Check an Official Check) or Bank Money Order on a State or National Bank or Savings and Loan Association, or State or Federally chartered Credit Union made payable to the Texas Transportation Commission in the following amount or Bid Bond in the same amount of:

ONE HUNDRED THOUSAND DOLLARS ($100,000.00).

A bid bond may be used as the required proposal guaranty. The bid bond form provided in this proposal is the only bid bond form acceptable and completed as required in the Instructions to Bidders in this proposal.

Any addenda issued amending this proposal and/or the plans that have been acknowledged by the bidder, become part of this proposal.

By signing the proposal the bidder certifies:

1. **The only persons or parties interested in this proposal are those named and the bidder has not directly or indirectly participated in collusion, entered into an agreement or otherwise taken any action in restraint of free competitive bidding in connection with the above captioned project.**
2. **In the event of the award of a contract, the organization represented will secure bonds for the full amount of the contract.**
3. **The signatory represents and warrants that they are an authorized signatory for the organization for which the bid is submitted and they have full and complete authority to submit this bid on behalf of their firm.**
4. **That the certifications and representations contained in the proposal are true and accurate and the bidder intends the proposal to be taken as a genuine government record.**

1)

Signature

Printed Name **Title**

Legal Company Name

Address

City, State, Zip

Phone Number

Email

2)

Signature

Printed Name **Title**

Legal Company Name

Address

City, State, Zip

Phone Number

Email

SSD(38) - SLBC SEALED BID

NEW MCKINNEY AEM FACILITY

LOCATION:	**2205 TX 5**
CITY/ST:	**MCKINNEY, TEXAS 75069**
COUNTY:	**COLLIN**
DISTRICT:	**DALLAS**
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BIDS MUST BE RECEIVED BY:	**NOON (12:00 PM CST) FOR 1:00 PM CST READING**
BID LOCATION:	**TxDOT STATE HEADQUARTERS**
BID ADDRESS:	**150 EAST RIVERSIDE DRIVE, 4N, AUSTIN, TEXAS 78704**

Texas Department of Transportation

SUPPORT SERVICES DIVISION (SSD)
FACILITIES PLANNING AND MANAGEMENT

RETURN COMPLETED PROPOSAL PACKAGE TO:
150 RIVERSIDE DR., 4th FLOOR-NORTH TOWER, AUSTIN, TX 78704
ATTN: Laura Mullins

AFFIX TO FRONT OF BID ENVELOPE FOR PROJECT

INSTRUCTIONS TO BIDDERS

Project ID: **18-470420012-REBID** County: **COLLIN**

Description: **NEW MCKINNEY AEM FACILITY** District: **DALLAS**

In response to the Governor's executive order effective March 10, 2021, TxDOT facilities have reopened to the public. TxDOT remains vigilant in evolving its safety procedures to ensure the protection and well-being of its employees and the public. Safety procedures currently in place for public meetings include, but not limited to, wearing face masks and social distancing.

PRE-BID MEETING

PRE-BID MEETING may be conducted on-site, virtual via WebEx, or both as indicated below.
On-site attendees must adhere to safety protocols including, but not limited to, wearing masks and social distancing.

PRE-BID MEETING DATE/TIME: **MAY 11, 2021 @ 1:00 PM CST**

ON-SITE: **2205 TX 5, MCKINNEY, TEXAS 75069**

VIRTUAL: **N/A**

WebEx Meeting number (access code): **N/A** Password: **N/A**

Optional WebEx Access (if applicable): Join by phone **+1-415-655-0003 United States TOLL**

Join from a video system or application Dial: N/A @txdot.webex.com
You can also dial 173.243.2.68 & enter your meeting number.

Join using Microsoft Lync or Microsoft Skype for Business Dial: N/A .txdot@lync.webex.com

OPTIONAL ON-SITE VISIT

An optional on-site visit may be offered at the discretion of the Project Manager. All attendees must RSVP prior to the site visit date with the Project Manager with the names of company members who will be attending. Masks and social distancing are required.

ON-SITE VISIT DATE/TIME: **N/A**

Contact Name / Phone: **N/A** **N/A**

BID LETTING

BID LETTING will be conducted as an open meeting AND virtually via WebEx meeting.
On-site attendees must adhere to safety protocols including, but not limited to, wearing masks and social distancing.

Bids for this project will be read: **JUNE 1, 2021 @ 1:00 PM CST**

ON-SITE: **150 East Riverside Drive, 4N, Austin, Texas 78704**
Attendees must check in at Security desk and be escorted to letting room.

VIRTUAL: **https://txdot.webex.com/**

WebEx Meeting Number (access code): **157 227 9284** Password: **38SSDcontracts**

Optional WebEx Access (if applicable): Join by phone **+1-415-655-0003 United States TOLL**

Attendees/guests may log in 15 minutes prior to meeting. Audio will be available 5 minutes prior. All phones will be muted.

PROPOSAL DELIVERY METHODS

SEALED BIDS will be accepted until 12:00 PM CST on the letting date and can be submitted by one of the following methods:

1. **ELECTRONICALLY*** by email to SSD_ContractLettings@txdot.gov

   Subject Line: BIDSUBMISSION: Project ID # 18-470420012-REBID

   ***** *Original endorsed / embossed Bid Bond or Bid Guarantee Check* ***MUST BE MAILED IN OR HAND DELIVERED AND PRESENT BY 12:00 PM CST ON THE LETTING DATE***

2. **MAIL / COURIER** (if not submitted electronically) shall be submitted in a sealed envelope addressed to:

   Texas Department of Transportation

   150 East Riverside Drive, 4N, Austin, Texas 78704

   Austin, Texas 78704

   ROUTINE FACILITIES CONTRACT (RFC) – SSD Attn: Laura Mullins

   (STAPLED ONLY – do not bind in notebooks or presentation folders)

3. **HAND DELIVERY (if not submitted electronically) shall be submitted in a sealed envelope addressed as above and placed in the DROP BOX located outside in front of above address.**

   (STAPLED ONLY – do not bind in notebooks or presentation folders)

All submitted bids will be opened at 1:00 PM CST, only successful bids will be read.

The proposal package (required documents) must arrive by NOON at the above location and in the hands of the letting official, by the specified bid date, regardless of the delivery method chosen by the bidder.

It is the responsibility of the contractor to ensure the delivery of the proposal package to the Letting Official.

TAC, Title 43, Rule §9.14(a). Submittal of Proposal

BID RESULTS

Preliminary bid results meet the basic criteria for submission and are considered accepted bids pending verification. Bid results will be posted on the SSD-Facilities Letting Business Page (listed below) within 48 hours after letting.

Official bid tabulations will be posted after all bid proposals have been validated and approved.

FACILITIES LETTING BUSINESS PAGE

Informational documents related to Facilities projects will be posted on the SSD-Facilities Letting Business Page at:

https://www.txdot.gov/business/letting-bids/facilities.html

Texas Department of Transportation

UNIFORM GENERAL CONDITIONS

TEXAS DEPARTMENT of TRANSPORTATION
125 E. 11th Street
Austin, Texas 78701

Support Services Division
Facilities Planning & Management Section
Riverside Annex, Bldg. 150-4 North

Revision Date: 12/28/2020

Table of Contents

Article 1 General Definitions

Unless the context clearly requires another meaning, the following terms have the meaning assigned herein.

1.1 **Addendum** means a change in proposal forms developed between advertising and bid submittal deadline. Addenda will be issued only by TxDOT and must be acknowledged by a bidder for his proposal to be publicly read.

1.2 **Advertisement** means the public announcement for work to be performed or materials to be furnished. The public announcement will be via the Electronic State Business Daily (ESBD) web site operated and maintained by the State acting through the Texas Comptroller of Public Accounts. (http://www.txsmartbuy.com/sp)

1.3 **Apparent Low Bidder** means the Bidder determined to have the numerically lowest total bid as a result of tabulation of bids by TxDOT.

1.4 **Architect/Engineer (A/E)** means a person registered as an architect pursuant to Tex. Occ. Code Ann., Chapter 1051, as a landscape architect pursuant to Tex. Occ. Code Ann., Chapter 1052, a person licensed as a professional engineer pursuant Tex. Occ. Code Ann., Chapter 1001 and/or a firm employed by TxDOT or Contractor to provide professional architectural and/or engineering services and to exercise overall responsibility for the design of a Project or a portion thereof, and to perform contract administration responsibilities as set forth in the Contract Documents.

1.5 **Authorization to Begin Work Letter** means the letter issued by TxDOT authorizing the Contractor to begin work in accordance with the provisions of the Contract and establishing the date stated in the Contract for completion of the Work, or establishing the beginning date time charges will commence for computing Contract Time for completion of the Work.

1.6 **Award** means the Commission's authorized representative's written acceptance of the Bidder's bid for a proposed Contract that authorizes TxDOT to enter into a Contract.

1.7 **Bid** means the offer of a Bidder for performing the Work described in the Contract Documents including any changes made by addendum.

1.8 **Bid Bond** means the security executed by the Bidder and the Surety furnished to TxDOT to guarantee payment of liquidated damages if the Bidder fails to enter into an awarded Contract.

1.9 **Bid Error** means a mathematical mistake made by a Bidder in an item number price entered into the proposal.

1.10 **Bid Form** means **Proposal Form.**

1.11 **Bidder** means an individual, partnership, limited liability company, corporation or joint venture submitting a bid for a proposed Contract.

1.12 **Building Contract** means a contract entered under Transportation Code, Chapter 223, Subchapter A for the construction or maintenance of a Department building or appurtenant facilities and considered to be a Highway Improvement Contract as defined in Texas Administrative Code, § 9.11.

1.13 **Business Day** means Monday through Friday, 8 a.m. to 5 p.m. excluding state and federal holidays.

1.14 **Calendar Day** means any day including Saturdays, Sundays, and legal holidays.

1.15 **Certificate of Insurance** means a form approved by the Department covering insurance requirements stated in the Contract.

1.16 **Change Order** means TxDOT's written order to the Contractor detailing changes to the specified Work, item quantities, or any other necessary modification of the Contract, at TxDOT's sole discretion.

1.17 **Claim** means a claim for compensation, for a time extension, or for any other remedy arising from a dispute, disagreement, or controversy concerning respective rights and obligations under the Contract.

1.18 **Commission** means the Texas Transportation Commission or authorized representative.

1.19 **Company** means the Bidder and/or Contractor.

1.20 **Contract** means the entire agreement between the Owner and the Contractor, including all of the Contract Documents, establishing the obligation of the parties for furnishing of materials and performance of the Work prescribed in the Contract Documents.

1.21 **Contract Documents** means the elements of the agreement (Contract) between the Owner and the Contractor. These include, but are not limited to, Bonds, Insurance, Plans, Shop Drawings, Specifications, Uniform General Conditions, Special Conditions, *Special Provisions*, *Special Specifications*, *Standard Specifications*, Change Orders, Bidding Documents, Advertisement, Bidder's Proposal, and all pre-bid addenda.

1.22 **Contractor** means the individual, company, partnership, limited liability company, corporation, or joint venture and all principals and representatives, jointly and severally, that are responsible for performance of a Contract awarded by TxDOT. In the event of termination for cause of a Contract with a Performance Bond the Surety becomes the Contractor.

1.23 **Contract Sum** means the total compensation payable to the Contractor for completion of the Work in accordance with the terms of the Contract.

1.24 **Contract Time** means the period of time from the date computation of time charges begin as set forth in the Authorization to Begin Work letter to the date stated in the Contract for completion of the Work, or the number of calendar days allowed in the Contract for completion of the Work, plus any TxDOT approved extensions.

1.25 **Day** means a calendar day, unless otherwise specifically stipulated.

1.30 **Dispute** means a disagreement between TxDOT and the Contractor or its authorized successor over the interpretation of the Contract Documents.

1.31 **District Representative (DR)** means the individual identified by TxDOT who will assist the Project Manager; perform periodic observations of the Work for general compliance with the plans and specifications; be the point of contact for coordination with the end-user for Work being conducted on an operational site; and perform other duties as specifically defined elsewhere in the Contract Documents and/or reflected in the Pre-construction Conference meeting minutes.

1.32 **Drawings** mean the sealed product of the Architect and/or Engineer which graphically depicts the Work.

1.33 **Engineer** see **Architect/Engineer (A/E)**.

1.34 **Environmental Laws** means Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended ("CERCLA") 42 U.S.C. §9601 et seq.; the Toxic Substance Control Act ("TSCAS"), 15 U.S.C. §2601 et seq.; the Hazardous Materials Transportation Act, 49 U.S.C. §1802; the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. §9601, et seq.; the Clean Water Act ("CWA"), 33 U.S.C. §1251 et seq.; the Safe Drinking Water Act, 42 U.S.C. §300f et seq.; the Clean Air Act ("CAA"), 42 U.S.C. §7401 et seq.; M.G.L. c. 21C and c. 21E; Texas Health and Safety Code Chapter 361; Texas Water Code Chapter 26; and any permits, licenses, approvals, plans, rules, regulations or ordinances adopted, or other criteria and guidelines promulgated pursuant to the preceding laws or other similar federal, state or local laws, regulations, rules or ordinances now in effect, or that may hereafter apply, relating to environmental matters.

1.35 **Executive Director** means the executive director of the Texas Department of Transportation.

1.37 **Final Acceptance** means the date determined and certified by the Architect/Engineer and TxDOT on which the Work is fully and satisfactorily complete in accordance with the Contract subject to the expiration of all warranty periods or any other overriding provision of the Contract Documents.

1.38 **Final Completion** means the date determined and certified by the Architect and/or Engineer, if applicable, and TxDOT on which the Work to the best of their information, knowledge and belief is fully and satisfactorily complete in accordance with the Contract subject to the expiration of all warranty periods or any other overriding provision of the Contract Documents.

1.39 **Hazardous Materials** means (i) hazardous wastes, hazardous substances, hazardous constituents, toxic substances or related materials, whether solids, liquids or gases, including but not limited to substances defined as "hazardous wastes," "hazardous substances," "oils," "toxic substances," "pollutants," "contaminants," "radioactive materials," or other similar designations in, or otherwise subject to regulation under, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended ("CERCLA"), 42 U.S.C. §9601 et seq.; the Toxic Substance Control Act ("TSCAS"), 15 U.S.C. §2601 et seq.; the Hazardous Materials Transportation Act, 49 U.S.C. §1802; the Resource Conservation and Recovery Act ("RCRA"), 42 U.S.C. §9601, et seq.; the Clean Water Act ("CWA"), 33 U.S.C. §1251 et seq.; the Safe Drinking Water Act, 42 U.S.C. §300f et seq.; the Clean Air Act ("CAA"), 42 U.S.C. §7401 et seq.; M.G.L. c. 21C and c. 21E; Texas Health and Safety Code Chapter 361; Texas Water Code Chapter 26; and in any permits, licenses, approvals, plans, rules, regulations or ordinances adopted, or other criteria and guidelines promulgated pursuant to the preceding laws or other similar federal, state or local laws, regulations, rules or ordinance now in effect, or that may hereafter apply, relating to environmental matters (collectively the "Environmental Laws"); and (ii) any other substances, constituents or wastes subject to any applicable federal, state or local law, regulation or ordinance, including any environmental law, now or hereafter in effect, including but not limited to (A) petroleum, (B) refined petroleum products, (C) waste oil, (D) waste aviation or motor vehicle fuel and (E) asbestos.; and (iii) any materials that, prior to execution of the Contract, were not designated as hazardous materials that, after execution of the Contract, become new hazardous materials subject to regulation under the aforementioned “Environmental Laws” and any applicable federal, state, or local law, regulation or ordinance.

1.40 **Letting** means the receipt, opening and determination of the apparent low Bidder.

1.41 **Letting Official** means the Executive Director or any TxDOT employee empowered by the Executive Director to officially receive and close the receipt of bids at a letting.

1.42 **Manufactured**, for the purposes of the *Buy America* provision of this Contract, means any process that modifies the chemical content, physical shape or size, or finish of a product. Manufacturing begins with initial melting and mixing and continues through fabrication (rolling, extruding, machining, bending, grinding, drilling, welding, cutting, etc.) and coating (paint, galvanizing, epoxy or any other coating that protects or enhances the value of the material.)

1.43 **Owner** means the State of Texas acting through the Texas Department of Transportation (TxDOT).

1.44 **Payment Bond** means the security executed by the Contractor and the Surety, furnished to the TxDOT obligating the Surety to guarantee payment of all legal debts of the Contractor pertaining to the Contract.

1.45 **Performance Bond** means the security executed on a form provided by TxDOT by the Contractor and the Surety, furnished to TxDOT to guarantee the completion of the Work in accordance with the terms of the Contract.

1.47 **Plans** mean Drawings.

1.48 **Power of Attorney for Surety Bonds** means an instrument under corporate seal appointing an attorney-in-fact to act on behalf of a Surety in signing bonds.

1.49 **Prime Contractor** means Contractor.

1.50 **Project** means all activities necessary for realization of the Work. This includes design, contract award(s), execution of the Work itself, and fulfillment of all Contract and warranty obligations.

1.51 **Project Manager (PM)** means the individual identified by TxDOT who will be responsible for the general administration of the Contract; is the single point of contact between TxDOT and the Contractor; conveys all directives on behalf of TxDOT to the Contractor; decides all questions which

may arise as to the quality or acceptability of materials furnished, work performed, and interpretations of the plans and specifications when such action is not a contravention of a design decision made by an Architect / Engineer in preparation of the plans and specifications or such action is in conflict with statutes under which the Architect or Engineer is licensed for the protection of the public health or safety; the manner of performance and rate of progress of the Work; and acceptable fulfillment of the Contract on the part of the Contractor unless otherwise specifically defined elsewhere in the Contract Documents.

1.52 **Project Site** means the real property on which the demolition, improvements, alternations, etc. as described in the Contract Documents will be implemented.

1.53 **Proposal** means the offer of the Bidder submitted on the prescribed form giving a bid price for performing the Work described in the plans and specifications and all addenda issued.

1.54 **Proposal Form** means the forms printed by the Bidder from the Electronic State Business Daily (ESBD) website operated and maintained by the State acting through the Texas Comptroller of Public Accounts.

1.55 **Proposal Guaranty** means the security designated in the proposal and furnished by the bidder as a guaranty that the bidder will enter into an awarded contract.

1.56 **Request for Proposal (RFP)** means a document generated by TxDOT which informs the Contractor of a proposed change in the Work, and appropriately describes or otherwise documents such proposed change.

1.57 **Responsive Bid** means a proposal that meets all requirements of the proposal form for acceptance.

1.58 **Routine Facilities Contract (RFC)** means a Contract let through the routine facilities contracting procedure for the construction or maintenance of a Department building or appurtenant facilities.

1.59 **Samples** mean representative physical examples of materials, equipment or workmanship, used to confirm compliance with requirements and/or to establish standards for use in execution of the Work.

1.60 **Schedule of Values** means the cost breakdown, in such detail as acceptable to TxDOT, of the materials, labor and equipment necessary to accomplish the Work as described in the Contract Documents, submitted by Contractor for approval by TxDOT.

1.61 **Shop Drawings** means the drawings, diagrams, illustrations, schedules, performance charts, brochures and other data prepared by the Contractor or its agents, which detail a portion of the Work.

1.62 **Site** see **Project Site**.

1.63 **Special Conditions** means supplemental additions or revisions to the Uniform General Conditions applicable to the Contract not covered by the Uniform General Conditions. Special Conditions are a part of the Contract Documents and have precedence over the Uniform General Conditions.

1.64 **Special Provisions** means additions or revisions to standard specifications.

1.65 **Specifications** means the written product of the Architect and/or Engineer, if applicable, that establishes the quality and/or performance of products utilized in the Work and processes/standards to be used, including testing and verification, for compliance.

1.66 **Standard Specifications** means the Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges adopted November 1, 2014 and updates as posted on TxDOT official website at *http://www.txdot.gov* and relevant to the Project.

1.67 **State** means the State of Texas.

1.68 **State Let Building Contract (SLBC)** means a Contract let through the state let building contracting procedure for the construction or maintenance of a Department building or appurtenant facilities.

1.69 **Subcontract** means the agreement between the Contractor and subcontractor establishing the obligations of the parties for furnishing of materials and performance of the Work prescribed in the Contract Documents.

1.70 **Subcontractor** means an individual, partnership, limited liability company, corporation, or any combination thereof that the Contractor sublets any portion of the Work or provide services, materials or equipment for use in the Work.

1.71 **Substantial Completion** means the stage of progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents, so that TxDOT employees and the public can safely occupy, utilize, and operate the improvements and all elements of the Work for purposes intended without hindrance or material interference from the Contractor's minor "punch list items" completion activities or on-going work performance of those portions of the Work not being considered for Substantial Completion. The date of Substantial Completion is the date established by the Contractor and TxDOT as set forth in the Certificate of Substantial Completion issued by TxDOT.

1.72 **Supplemental Instruction** means a written order issued by the PM or authorized representative making minor changes in the Work not involving an adjustment in the Contract Sum or an extension of the Contract Time.

1.73 **TxDOT** means the Texas Department of Transportation acting on behalf of the State of Texas.

1.74 **Unit Price Work** means Work or a portion of the Work paid for based on incremental units of measurement.

1.75 **Unilateral Change Order (ULCO)** means a Change Order issued by TxDOT without the agreement of the Contractor.

1.76 **Work** means the administration, procurement, materials, equipment, construction and all services necessary for the Contractor, or its agents or both, to fulfill the Contractor's obligations under the Contract**.**

Article 2 Procedures Governing Bidding

2.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

2.2 EXAMINING DOCUMENTS AND WORK LOCATIONS

2.2.1 Examine the proposal form, plans, and specifications, and specified work locations before submitting a bid for the work. Submitting a bid will be considered evidence that the Bidder has performed the examination. For plans which include data for borings, soil profiles, ground water elevations, and underground utilities the information was obtained for use by TxDOT in the preparation of the plans. This information is provided for the Bidder's information only and TxDOT makes no representation as to the accuracy of the data.

2.2.2 Oral explanations, instructions, or consideration of Contractor-proposed changes in the proposal form given during the bidding process are not binding. Only requirements included in the proposal form, associated uniform general conditions, specifications, plans and TxDOT-issued addenda are binding. Request explanations of documents in adequate time to allow TxDOT to reply before the bid opening.

2.2.3 Immediately notify TxDOT of any error, omission, or ambiguity discovered in any part of the proposal form and Contract documents. TxDOT will issue addenda when appropriate.

2.3 ELIGIBLE BIDDER

2.3.1 To be eligible to bid on a building contract a potential bidder must satisfactorily comply with any financial, experience, technical, or other requirement contained in the governing specifications applicable to the project in accordance with Texas Administrative Code Rule §9.12 (e).

2.4 PREPARING AND SUBMITTING THE BID

2.4.1 **Proposal Form.** Prepare the bid on the proposal form provided by TxDOT. Documents may be obtained electronically at the Electronic State Business Daily (ESBD) website operated and maintained by the State acting through the Texas Comptroller of Public Accounts. *http://www.txsmartbuy.com/sp*.

2.4.1.1 Execute the proposal form in ink with the complete and correct name of the individual, firm, corporation or combination thereof making the proposal. The person authorized to bind the Bidder or Bidders must sign the proposal. Specify a price in dollars and cents for each bid item and if included each allowance item on the proposal form.

2.4.2 **Proposal Guaranty.** Provide a proposal guaranty in the amount indicated on the proposal form. Use either a guaranty check or a printed bid bond. If a proposal guaranty is not required it will state so on the proposal form.

2.4.3 **Guaranty Check.** Make the check payable to the Texas Transportation Commission or the Texas Department of Transportation. The check must be a cashier's check, money order, or teller's check drawn by or on a state or national bank, or a state or federally chartered credit union (collectively referred to as a "bank"). The check must be dated on or before the date of the bid opening. Postdated checks will not be accepted. The type of check or money order must be indicated on the face of the instrument, except in the case of a teller's check, and the instrument must be no more than 90 days old. A check must be made payable at or through the institution issuing the instrument; or drawn by a bank and on a bank; or be payable at or through a bank. TxDOT will not accept personal checks, certified checks, or other types of money orders.

2.4.4 **Bid Bond.** Use the bid bond form provided by TxDOT. Submit the bid bond in the amount specified with the powers of attorney dated and attached. Retyped copies of the bid bond form will not be accepted. The bond must be dated on or before the date of the bid opening, bear the impressed seal of the Surety, and be signed by the Bidder or Bidders and an authorized individual of the Surety. As an alternative for joint venture Bidders, each of the Bidders may submit a separate bid bond completed as outlined in this Section. Bid bonds will only be accepted from Sureties authorized to execute a bond under and in accordance with State law.

2.4.5 **Addendum.** Verify if addenda have been issued for the proposed Contract. If addenda have been issued they must be acknowledged on the Addendum Acknowledgment form. Submit the Addendum Acknowledgment form with the proposal.

2.4.6 **HUB Subcontracting Plan.** If a HUB Subcontracting Plan is required it will be so stated on the proposal form. If a HUB Subcontracting Plan is required complete and sign the HUB Subcontracting Plan (HSP) and submit with the proposal.

2.4.7 **Department of Homeland Security (DHS) E-Verify Registration.** Register in the DHS E-Verify system. Remain active in E-Verify throughout the life of the contract. Subcontractors must also register and remain active in E-Verify until their work is completed.

2.4.8 **Submittal of Bid.** Place the completed proposal form and the proposal guaranty in a sealed envelope marked to indicate the contents.

2.4.8.1 When submitting by mail or delivery service, place the envelope in another sealed envelope and address as indicated in the official advertisement. It is the Bidder's responsibility to ensure that the sealed bid arrives at the location described on or before the time and date set for the bid opening. To be accepted, the bid must be in the hands of the Letting Official by the time and date set for the receipt of proposals, regardless of the method chosen for delivery.

2.4.9 **Revising the Proposal Form.** Make desired changes to the Bidder entered information on the proposal form in ink, initial each change made, and submit the proposal to the Letting Official. TxDOT will not make revisions to a bid on behalf of a Bidder.

2.4.10 **Withdrawing a Bid.** Submit a written request to withdraw a bid before the time and date set for the receipt of proposals. TxDOT will not accept oral requests. A written request must be signed and submitted to the Letting Official with proof of identification. The request must be made by a person authorized to bind the Bidder or Bidders. In case of joint venture, TxDOT will accept a request from a person authorized to bind a party to the joint venture. TxDOT may require written delegation of authority to withdraw a bid when the individual sent to withdraw the bid is not authorized to bind the Bidder or Bidders.

2.5 OPENING AND READING OF BIDS

2.5.1 **Reading of Bids.** At the time, date, and location specified in the official advertisement, the Letting Official will publicly open and read bids. A bid determined to be nonresponsive may or may not be read.

2.5.2 **Nonresponsive Bid.** TxDOT will not accept a nonresponsive bid. A bid that has one or more of the deficiencies listed below is considered nonresponsive:

2.5.2.1 the bid was not in the hands of the Letting Official at the time and location specified in the advertisement,

2.5.2.2 a bid was submitted for the same proposal form by a Bidder or Bidders and one or more of its partners or affiliates,

2.5.2.3 the Bidder did not acknowledge or improperly acknowledged all addenda,

2.5.2.4 the Bidder is suspended or debarred by the Commission, Department, or any federal agency,

2.5.2.5 the Bidder was prohibited from rebidding a specific proposal form due to failure to enter into a Contract on the original award,

2.5.2.6 the bidder failed to enter into a Contract on the original award,

2.5.2.7 the Bidder was defaulted or terminated on the original Contract, unless TxDOT terminated in the best interest of the State or the public,

2.5.2.8 the Bidder or a subsidiary or affiliate of the Bidder has received compensation from TxDOT to participate in the preparation of the plans or specification or both on which the bid or Contract is based,

2.5.2.9 the Bidder's HUB Subcontracting Plan was determined by TxDOT to be non-compliant,

2.5.2.10 the Bidder did not submit a HUB Subcontracting Plan when it was required to be submitted,

2.5.2.11 the Bidder failed to participate in the Department of Homeland Security's (DHS) E-Verify System as specified above,

2.5.2.12 the proposal guaranty did not comply with the requirements contained in this Article,

2.5.2.13 the proposal form was not signed,

2.5.2.14 the proposal form was signed by a person who was not authorized to bind the Bidder or Bidders,

2.5.2.15 a bid item or allowance item or both are left blank,

2.5.2.16 the bid was in a form other than TxDOT official proposal form,

2.5.2.17 the Bidder modified the bid in a manner that altered the conditions or requirements for work as stated in the proposal form as determined solely by TxDOT,

2.5.2.18 certifications were not acknowledged,

2.5.2.19 the Bidder did not attend a mandatory pre-bid conference.

2.6 CONSIDERATION OF BID ERRORS

2.6.1 **Consideration.** TxDOT will consider a claim of a bid error by the apparent low Bidder if the following requirements have been met:

2.6.1.1 a written notification is submitted to TxDOT within 5 business days after the date the bid is opened; and

2.6.1.2 the submittal identifies the items of work involved and include bidding documentation. TxDOT may request clarification of submitted documentation.

2.6.2 **Evaluation.** TxDOT will evaluate the claim of an error by the apparent low Bidder by considering the following:

2.6.2.1 the bid error relates to a material item of work,

2.6.2.2 the bid error amount is significant portion of the total bid,

2.6.2.3 the bid error occurred despite the exercise of ordinary care, and

2.5.2.4 the delay of the proposed work will not impact cost and safety to the public.

2.6.3 **Acceptance.** Acceptance of the bid error claim by TxDOT will result in the rejection of all bids. The erring Contractor will not be allowed to bid the project when it is re-let. Rejection of bids due to the Contractor's bid error may result in the application of sanctions by TxDOT.

2.7 TIE BIDS

2.7.1 **Tie Bids.** If the bid amount for 2 or more Bidders is equal and those bids are the lowest responsive bids submitted, each tie Bidder will be given an opportunity to withdraw their bid. If 2 or more tie Bidders and do not withdraw their bids, the low Bidder will be determined by a coin toss or a series of coin tosses when there are more than 2 Bidders. If all Bidders request to withdraw their bids, no withdrawals will be allowed and the low Bidder will be determined by a coin toss or a series of coin tosses when there are more than 2 Bidders. The Letting Official will preside over the proceedings.

2.8 RETURN OF PROPOSAL GUARANTY

2.8.1 **Proposal Guaranty Check** The proposal guaranty check of all Bidder's except the apparent low Bidder will be returned via U.S. mail to the address specified on TxDOT Return Bid Guaranty Check Form by the Bidder.

2.8.2 **Bid Bond.** Bid bonds will not be returned.

Article 3 Award and Execution of Contract

3.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

3.2 AWARD OF CONTRACT

3.2.1. **Time.** The Commission or designated representative will award, reject, or defer the Contract within 30 days after the opening of the proposal.

3.2.2. **Reservations.** TxDOT reserves the right to reject any or all proposals and to waive technicalities in the best interest of the State.

3.2.3. **Award.** The Commission or designated representative will award the Contract to the Bidder with the lowest responsive bid (low Bidder). The Commission or designated representative may award a Contract to the Bidder with the second lowest responsive bid (second lowest Bidder) when the following requirements have been met:

3.2.3.1 the Contract is for work with a TxDOT estimated cost to construct of less than $300,000 and the Contract does not include federal funds,

3.2.3.2 the low Bidder withdraws its bid or fails to enter into Contract,

3.2.3.3 the second lowest Bidder agrees to perform the work for the amount of the low Bidder,

3.2.3.4 the Executive Director or designated representative recommends in writing the award of the Contract to the second lowest Bidder, and

3.2.3.5 the Commission or designated representative agrees with the Executive Director or designated representative's recommendation for award to the second lowest Bidder.

3.2.4. **Rejection.** The Commission or designated representative will reject the Contract if:

3.2.4.1 the low bid contains a bid error that in the sole determination of TxDOT satisfies the requirements and criteria in *Article 2*, or

3.2.4.2 rejection of the Contract is in the best interest of the State.

3.3 RESCINDING OF AWARD

3.3.1 **Award Cancel.** The Commission or designated representative reserves the right to cancel the award of any Contract before contract execution with no compensation due when the cancellation is in the best interest of the State. TxDOT will return the proposal guaranty to the Contractor.

3.4 **EXECUTION OF CONTRACT.** Provide the following within fifteen (15) days after written notification of award of the Contract. If bonds are not required provide the following within seven (7) days after written notification of award of the Contract.

3.4.1. **Contract.** Execute the Contract as prescribed by TxDOT.

3.4.2. **Bonds.** Tender to TxDOT performance and payment bonds in accordance with Table 1. Execute and date the performance and payment bond in the full amount of the Contract with the powers of attorney. Furnish the payment and performance bond as guaranty for the protection of the claimants and TxDOT for labor and materials and the faithful performance of the Work in accordance with the Contract Documents.

3.4.2.1 Each bond shall be executed on TxDOT's form by a corporate surety or sureties authorized to do business in the State of Texas, acceptable to TxDOT and in compliance with relevant provisions of the Texas Insurance Code. If a Surety upon a bond loses its authority to do business in the State, the Surety's underwriting limitation drops below the required bond amount or the Surety is declared bankrupt or insolvent, the Contractor shall, within fifteen (15) days after occurrence of any of the aforementioned events, furnish a replacement bond at no added cost to TxDOT. In such event the Work will be suspended until a substitute Surety acceptable to TxDOT is provided and a non-compensable time extension to the Contract will be granted for the fifteen (15) days or thirty (30) days if an acceptable Surety is not readily provided, whichever is sooner. The Contractor's inability to find an acceptable Surety within thirty (30) days will be deemed a breach of contract and TxDOT may, in its sole discretion assess liquidated damages or declare the Contract in default and terminate the Contract

Table 1

Bonding Requirements

Contract Amount	Required Bonds
Less than $25,000	None
$25,000 to $100,000	Payment
More than $100,000	Performance and Payment

3.4.2.2 The process of requiring and accepting bonds and making claims thereunder shall be conducted in compliance with Tex. Gov't Code, Chapter 2253. **IF FOR ANY REASON A STATUTORY PAYMENT OR PERFORMANCE BONDS IS NOT HONORED BY THE SURETY, THE CONTRACTOR SHALL FULLY INDEMNIFY AND HOLD THE OWNER HARMLESS OF AND FROM ANY COSTS, LOSSES, OBLIGATIONS OR LIABILITIES IT INCURS AS A RESULT.**

3.4.3. **Insurance.** Submit a certificate of insurance on TxDOT's form showing coverages in accordance with Contract requirements.

3.4.3.1 Insurance must cover the work for the duration of the Contract and must remain in effect until final acceptance. Failure to obtain and maintain insurance for the contracted Work may result in suspension of work or default of the Contract. If the insurance expires and coverage lapses for any reason, stop all work until TxDOT receives an acceptable certificate of insurance. Time charges will not stop for work stoppage due to expired insurance.

3.4.3.2 Provide TxDOT with a certificate of insurance verifying the types and amounts of coverage shown in Table 2. TxDOT shall not be deemed or construed to have assessed the risk that may be applicable to the Contractor under the Contract. The Contractor shall assess its own risks and if it deems appropriate or prudent or both, maintain higher limits or broader coverages or both at no additional cost to TxDOT.

Table 2

Insurance Requirements

Type of Insurance	**Amount of Coverage**
Commercial General Liability Insurance	Not Less Than: $600,000 each occurrence
Business Automobile Policy	Not Less Than: $600,000 combined single limit
Workers' Compensation *	Not Less Than: Statutory - Texas
All Risk Builder's Risk Insurance **	100% of Contract Amount

* The Workers' Compensation policy must include a waiver of subrogation endorsement in favor of TxDOT.

** The All Risk Builder's Risk Insurance policy must name TxDOT as Loss Payee. Coverage shall include, but not be limited to, loss by fire, storm, extended coverage perils on work and materials intended for use on the project including adjacent structure, and damage resulting from faulty workmanship, materials, or design provided directly or indirectly by the Contractor.

3.4.3.3 By signing the Contract, the Contractor certifies compliance with all applicable laws, rules, and regulations pertaining to workers' compensation insurance. This certification includes all subcontractors. Pay all deductibles stated in the policy. Subcontractors must meet the requirements of Table 2 either through their own coverage or through the Contractor's coverage.

3.4.3.4 In the event the Contractor does not provide Workers' Compensation Insurance coverage for each Subcontractor and all sub-tier subcontractors employed on the project the Contractor shall provide TxDOT with a current Workers' Compensation Insurance coverage certificate for each Subcontractor and all sub-tier subcontractors employed on the project in accordance with Texas Labor Code §406 .096(b).

3.4.4 **Business Ownership Information.** Submit the names and social security numbers of each individual owning 25% or more of the firm, or firms in the case of a joint venture, on TxDOT's form.

3.4.4.1 Provide written notification to TxDOT immediately upon discovery information provided was erroneous when submitted or has become erroneous by reason of changed circumstances.

3.4.5 **Certificate of Interested Parties (Form 1295).** Submit the form at contract execution for;

3.4.5.1 contracts awarded by the Commission

3.4.5.2 contracts with award amounts of $1,000,000 or more

3.4.5.3 when an existing contract increases in value to $1,000,000 or more

3.4.5.4 when there is an increase of $1,000,000 or more to an existing contract,

3.4.5.5 or when there is a change to the information in the Form 1295.

3.5 FAILURE TO ENTER CONTRACT

3.5.1 **Proposal Guaranty.** If the Contractor fails to comply with all the requirements in this Article, the proposal guaranty will become the property of the State, not as a penalty, but as liquidated damages. The Contractor forfeiting the proposal guaranty will not be considered in future proposal for the same work unless there has been a substantial change in design of the work.

3.6 RETURN OF PROPOSAL GUARANTY

3.6.1. **Guaranty Check.** The proposal guaranty check of the low Bidder will be retained until after the Contract has been rejected or awarded and executed by TxDOT. The guaranty check will be returned via U.S. mail to the address specified on TxDOT Return Bid Guaranty Check Form by the Bidder.

3.6.2. **Bid Bond.** Bid bond will not be returned.

3.7 BEGINNING OF WORK

3.7.1. **Written Authorization.** Do not start work until receipt of the authorization to begin work letter issued by TxDOT. Do not start work at the project site until completion of the pre-construction meeting.

3.8 **ASSIGNMENT OF CONTRACT**. Do not assign, sell, transfer or otherwise dispose of the Contract or any portion, rights, title, or interest (including claims) without the approval of the company or designated representative. TxDOT must deem any proposed assignment justified and legally acceptable before the assignment can take place. Any assignment without TxDOT approval is void.

3.9 **EXCLUDED PARTIES**. The Contractor certifies by signing the Contract that the Contractor will not enter into any subcontract with a subcontractor that is debarred or suspended by TxDOT or any federal agency.

3.10 **NOTICE OF STATE AUDIT AUTHORITY**. The state auditor may conduct an audit or investigation of any entity receiving funds from the state directly under the Contract or indirectly through a subcontract under the Contract. Acceptance of funds directly under the Contract or indirectly through a subcontract under this Contract acts as acceptance of the authority of the state auditor, under the direction of the legislative audit committee, to conduct an audit or investigation in connection with those funds. An entity that is the subject of an audit or investigation must provide the state auditor with access to any information the state auditor considers relevant to the investigation or audit.

Article 4 Laws Governing Construction

4.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS**. In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

4.2 **COMPLIANCE WITH LAWS**. Become familiar with and, at all times, comply with all applicable State and Federal laws, statutes, ordinances and regulations including but not limited to, laws governing labor, equal employment opportunity, safety, environmental protection, antiquities and primitive records preservation, and prevailing wage rates which, in any manner, affect the conduct of the Work.

4.2.1 **Fees and Permits.** Cooperate with governmental officials at all times where their jurisdiction applies. Apply for, pay all fees and provide supporting documentation necessary to secure permits, licenses, certificates, etc. which are required for performance of the Work. TxDOT hereby affirms the Contractor is not required to obtain building permits nor secure inspections by local jurisdictions for Work performed on State property. Any Texas Accessibility Standards (TAS) compliance review and inspection fees will be the responsibility of TxDOT.

4.2.2 **Change in Laws**. If there is any change between the date the Contract is executed and Final Completion in any applicable legal requirements which require a change in the Work in order to avoid a violation of any such applicable legal requirement, Contractor shall be responsible for changing the Work in order to avoid a violation of such legal requirements. A Change Order shall be executed to adjust the Contract Sum and/or Contract Time, if applicable, as a result of a change in legal requirements. If there is a change in any applicable legal requirement but the Work or portion thereof affected by such change is deemed to be "grandfathered" (i.e., the applicable legal requirement does not require that the Work be changed), such portion of the Work shall nevertheless be deemed to be in compliance with such applicable legal requirements and Contractor shall not be required to change the Work to otherwise comply with such changed legal requirements.

4.3 **ENVIRONMENTAL LAWS**. Conduct activities in compliance with applicable Environmental Laws and regulations and other requirements of the Contract relating to the environment, and its protection at all times.

4.3.1 **Hazardous Materials.** Contractor is responsible for all items it brings to site, including Hazardous Materials, and all such items brought to the site by its subcontractors and suppliers, or by other entities subject to direction of the Contractor. Contractor is responsible for the cost of any environmental remediation required resulting from the action or inaction of its employees, subcontractors, suppliers, or by other entities subject to direction of the Contractor.

4.3.1.1 Do not incorporate hazardous materials into the Work without prior written approval of TxDOT, and provide an affidavit attesting to such in association with request for Substantial Completion inspection.

4.4 **WAGE RATES.** Do not pay less than the wage scale of the various classes of labor as set forth in 29 USC Section 206. Published wage rates for the State of Texas and county of the project can be located at *https://beta.sam.gov/* (Davis-Bacon Act) pursuant to Chapter 2258, Texas Government Code. The specified wage rates are minimum rates only and no representation is made that qualified labor adequate to perform the Work is available locally at the prevailing wage rates. The Contractor or Subcontractor shall pay overtime wages as required by the Fair Labor Standards Act, 29 United States Code 201, et. seq.

4.5 **RECORDS.**. In accordance with Texas Government Code, Title 5, Subtitle A, Chapter 552 the Contractor shall make any information created, maintained, or exchanged with the State pursuant to the Contract, (public information) and not otherwise excepted from disclosure under the Texas Public Information Act, available to the State at no additional cost to unit.

4.5.1 Contractor and all Subcontractors shall keep, or cause to be kept, copies of weekly payrolls for review by TxDOT for a period of three years after completion of the project in accordance with Texas Administrative Code, Title 43, Part 1, Chapter 9, Subchapter A, Rule §9.5. As a condition of payment and pursuant to Texas Government Code §2113.102, TxDOT internal audit staff may audit the Contractor and Subcontractor during normal business hours.

4.5.2 By entering into Contract, the Contractor agrees to provide or make available to the Department and any authorized governmental agency all records, including electronic and payment records related to the Contract for a period required in accordance with the Texas Administration Code, Title 43, Part 1, Chapter 9, Subchapter K, Rule §9.327, *Contractor Records*. Additionally, subcontracts shall include a clause adhering to the same requirement. Failure to provide access to the required documents by any party to the project may result in action by the State.

4.6 **VENUE FOR SUITS.** Venue for any suit arising from this Contract will be in a court of competent jurisdiction in Travis County, Texas.

4.7 **LICENSING OF TRADES**. Contractor shall comply with all applicable provisions of state law related to license requirements for professionals, skilled tradesmen, contractors, materialmen, suppliers and or laborers, as necessary to accomplish the Work.

4.7.1 **Loss of License.** In the event the Contractor, or one of its Subcontractors or sub-tier contractors, loses its license during the term of performance of the Contract, the Contractor shall promptly hire or contract or cause to hire or contract with a licensed provider of the service at no additional cost to TxDOT.

4.8 **STATE SALES AND USE TAXES.** TxDOT qualifies for exemption from State and Local Sales and Use Taxes pursuant to the provisions of Tex. Tax Code, Chapter 151. Contractor shall claim exemption from payment of applicable State taxes by complying with such procedures as prescribed by the State Comptroller of Public Accounts in Title 34 Texas Administrative Code §3.287.

Article 5 General Responsibilities of Owner and Contractor

5.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS**. In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

5.2 **OWNER'S GENERAL RESPONSIBILITIES**. Owner is the entity identified as such in the Contract and referred to throughout the Contract Documents as if singular in number

5.2.1 **Preconstruction Conference**. After the issuance of the Authorization to Begin Work Letter but prior to the commencement of time charges a conference will be convened for attendance by the TxDOT Project Manager (PM), Contractor, and others as deemed appropriate by the PM. The purpose of the conference is to establish a working understanding among the parties as to the Work, the operational conditions at the project site, general administration of the Contract, effective communications between the project team members, and address any other item set forth in the preconstruction conference agenda. PM will provide an agenda for the preconstruction conference.

5.2.2 **TxDOT Project Manager (PM).**

5.2.2.1 Prior to the start of construction, TxDOT will identify the Owner's Representative also known as the TxDOT Project Manager

5.2.2.2 will be responsible for the general administration of the Contract;

5.2.2.3 is the single point of contact between TxDOT and the Contractor;

5.2.2.3.1 Notice to the PM, unless otherwise noted, constitutes notice to TxDOT under the Contract.

5.2.2.4 will convey all directives on behalf of TxDOT to the Contractor;

5.2.2.5 will decide all questions which may arise as to the quality or acceptability of materials furnished, work performed, and interpretations of the plans and specifications when such action is not a contravention of a design decision made by an Architect or Engineer in preparation of the plans and specifications or such action is in conflict with statutes under which an Architect or Engineer is licensed for the protection of the public health or safety; the manner of performance and rate of progress of the Work and acceptable fulfillment of the Contract on the part of the Contractor,

5.2.2.5.1 unless otherwise specifically defined elsewhere in the Contract Documents or conveyed to the Contractor in writing.

5.2.3 **TxDOT District Representative (DR)**.

5.2.3.1 Prior to the start of construction, TxDOT will identify the District Representative (DR) who will assist the Project Manager (PM)

5.2.3.2 will perform periodic observations of the Work for general compliance with the plans and specifications;

5.2.3.3 will be the point of contact for coordination with the end-user for Work being conducted on the operational site;

5.2.3.4 will perform other duties as specifically defined in the Contract Documents, reflected in the Pre-construction Conference meeting minutes, or conveyed to the Contractor in writing by the PM.

5.2.4 **TxDOT Supplied Materials and Information.** TxDOT shall **p**rovide information, equipment, or services under TxDOT's control required by the Contract Documents to the Contractor with reasonable promptness.

5.2.5 **Availability of Lands.** Provide property access license(s) for permanent infrastructure on State property when so required for execution of the Work, unless otherwise required in the Contract Documents.

5.2.6 **Limitation on Owner's Duties.** TxDOT and its consultants will not supervise, direct, control or have authority over or be responsible for Contractor's means, methods, technologies, sequences or procedures of construction or the safety precautions and programs incident thereto. TxDOT is not responsible for any failure of Contractor to comply with laws and regulations applicable to the Work. TxDOT is not responsible for the failure of Contractor to perform or furnish the Work in accordance with the Contract Documents. TxDOT is not responsible for the acts or omissions of Contractor, or any of its subcontractors, suppliers or of any other person or organization performing or furnishing any of the Work directly or indirectly on behalf of the Contractor.

5.2.7 **Site Visits.** Make site visits at intervals and in accordance with notification provisions as provided in the Contract Documents to observe the progress and quality of the various aspects of Contractor's executed Work and report findings. TxDOT retains the sole authority to accept or reject Work and issue direction for correction, removal, or replacement of Work.

5.2.8 **Clarifications and Interpretations.** Provide clarifications or interpretations of the plans and specifications when determined by TxDOT to be necessary. The PM or designated representative will provide such clarifications or interpretations consistent with the intent of the plans and specifications with reasonable promptness to the Contractor as Supplemental Instruction (SI) or similar instrument. TxDOT shall respond to request for clarifications or interpretations

within fourteen (14) calendar days of receipt of such request. If the services of a TxDOT consultant are required for a clarification or interpretation of a request TxDOT will respond within twenty one (21) calendar days of receipt of such request. Clarifications to the drawings and specifications by TxDOT are not considered changes to the drawings and specifications.

5.3 **ROLE OF ARCHITECT / ENGINEER (A/E).** To the extent specified in the Contract between TxDOT and the Architect/Engineer, the A/E shall provide general administration services for TxDOT during the construction phase of the Project. Written correspondence, requests for information, and shop drawings/submittals shall be directed to the TxDOT PM with a copy to the A/E. The A/E has the authority to act on behalf of TxDOT to the extent provided in the Contract Documents, unless otherwise modified by written instrument, which will be furnished to the Contractor by the PM, upon request.

5.3.1 **Site Visits**.

5.3.1.1 The A/E will make visits to the site at intervals as provided in the A/E's contract agreement with TxDOT, to observe the progress and the quality of the various aspects of Contractor's executed Work and report findings to TxDOT.

5.3.1.2 The A/E has the authority to interpret plans and specifications provided by the A/E and inspect the Work covered by same for compliance and conformance with the plans and specifications. TxDOT retains the sole authority to accept or reject Work and issue direction for correction, removal, or replacement of Work.

5.3.2 **Clarifications and Interpretations**. It may be determined that clarifications or interpretations of the plans and specifications provided by the A/E are necessary. Upon direction by the PM such clarifications or interpretations will be provided by the A/E consistent with the intent of the aforementioned plans and specifications. The A/E will issue these clarifications with reasonable promptness to the PM as Architect's Supplemental Instruction (ASI) or similar instrument. The PM will be responsible for transmittal of an ASI to the Contractor. If the Contractor believes that such clarification or interpretation justifies an adjustment in the Contract Sum or the Contract Time, the Contractor shall so notify TxDOT in accordance with the provisions of ***Article 14***.

5.3.3 **Limitations on Architect / Engineer Authority**. The A/E is not responsible for:

5.3.3.1 The Contractor's means, methods, techniques, sequences, procedures, safety, or programs incident to the Project nor will the A/E supervise, direct, control or have authority over the same.

5.3.3.2 The failure of Contractor to comply with laws and regulations applicable to the furnishing or performing the Work.

5.3.3.3 The Contractor's failure to perform or furnish the Work in accordance with the Contract Documents.

5.3.3.4 Acts or omissions of the Contractor, or of any other person or organization performing or furnishing any of the Work.

5.4 **CONTRACTOR'S GENERAL RESPONSIBILITIES.** Contractor is solely responsible for implementing the Work in full compliance with all applicable laws and the Contract Documents and shall supervise and direct the Work using the best skill and attention to assure that each element of the Work conforms to the Contract requirements. Contractor is solely responsible for all construction means, methods, techniques, safety, sequences, coordination and procedures

5.4.1 **Beginning of Work**. The Contractor shall not begin work until authorized by TxDOT in the Authorization to Begin Work letter.

5.4.2 **Services, Materials, and Equipment**. Unless otherwise specified, provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities, incidentals, and services necessary for the construction, performance, testing, start-up, inspection and completion of the Work.

5.4.3 **Cooperation of Contractor**. Cooperate with TxDOT, TxDOT representatives, other contractors, utility companies, governmental / regulatory agency representatives, etc. whose work/operations are directly or indirectly impacted by the execution of the Work. At the written request of TxDOT, the Contractor shall immediately remove from the work locations any employee or representative of the Contractor or a subcontractor who, in the option of TxDOT, displays uncooperative behavior or who is disrespectful, disorderly, or otherwise objectionable. These individuals may not be reinstated without the written consent of TxDOT.

5.4.4 **Contractor's Superintendent.** Employ a competent superintendent who will be present at the Project Site during the progress of the Work. The superintendent proposed for the project is subject to the approval of the PM. Approved superintendents may not be changed during the course of the project without the written approval of the PM, unless the superintendent leaves the employ of the Contractor.

5.4.5 **Project Administration.** Provide project administration for all subcontractors, sub-tier contractors, vendors, suppliers, and others involved in implementing the Work and shall coordinate administration efforts with those of the PM in accordance with any applicable provision of the Contract Documents.

5.4.6 **Communications.** The Contractor will direct all communications to TxDOT through the PM or designated representative(s).

5.4.7 **Non-Compliant Work.** Should the PM or designated representative identify Work as non-compliant with the Contract Documents, the PM will communicate the finding to the Contractor and the Contractor will correct such Work at its expense.

5.4.8 **Cleaning.** At all times, keep the Site and the Work clean and free from accumulation of waste materials or rubbish caused by the construction activities under the Contract.

5.4.9 **Labor.** Provide competent, suitably qualified personnel to provide any services required to construct the Work as required by the Contract Documents and maintain good discipline and order at the Site at all times. At the written request of TxDOT, Contractor shall immediately remove from the work locations any employee or representative of the Contractor or a subcontractor who, in the sole opinion of TxDOT, does not perform work in a proper and skillful manner and may not reinstate these individuals without the written consent of TxDOT.

5.4.10 **Subcontractors.**

5.4.10.1 Do not employ, directly or indirectly, any Subcontractor, supplier or other person or organization, whether initially or as a substitute, against whom TxDOT may have reasonable objection. TxDOT will communicate such objections in writing. The Contractor is not required to employ any Subcontractor, supplier or other person or organization to furnish any of the work to whom the Contractor has reasonable objection.

5.4.10.2 Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, suppliers and other persons and organizations performing or furnishing any of the Work under a direct or indirect contract with the Contractor. Upon written request of the PM, the Contractor shall promptly furnish to TxDOT a copy of any specified subcontract promptly. The Contractor agrees that TxDOT has no obligation to review or approve the content of such contracts and that providing TxDOT such copies in no way relieves the Contractor of any of the terms and conditions of the Contract, including, without limitation, any provisions of the Contract which require the Subcontractor to be bound to the Contractor in the same manner in which the Contractor is bound to TxDOT.

5.4.10.3 Do not substitute Subcontractors without the acceptance of TxDOT and compliance with the conditions of the HUB Subcontracting Plan if applicable. Subcontracts and supply contracts shall be consistent with and bound to the terms and conditions of the Contract Documents including provisions of the Agreement between the Contractor and TxDOT. Require all Subcontractors, suppliers and such other persons and organizations performing or furnishing any of the Work to communicate with TxDOT only through the Contractor.

5.4.10.4 Contractor shall require all subcontractors to register and remain active in the Department of Homeland Security's (DHS) E-Verify System until their work is complete on the project.

5.4.11 **Availability of Other Lands**. The Contractor shall be solely responsible for obtaining authorization and pay any related fees to work within lands not under the sole control of TxDOT.

5.4.12 **Laws to be Observed**. Become familiar with and, at all times, observe and comply with all Federal and State laws and regulations which in any manner affect the conduct of the Work.

5.4.13 **Ancillary Areas**. Operate and maintain operations and associated storage areas at the site of the Work in accordance with the following:

5.4.13.1 Confine all operations, including storage of materials and employee parking upon the Site of Work, to areas designated by the PM or DR.

5.4.13.2 The Contractor may erect, at its own expense, temporary buildings that will remain its property and shall remove such buildings and associated utility service lines upon completion of the Work, unless the Contractor requests and TxDOT provides written consent that it may abandon such buildings and utilities in place.

5.4.13.3 Use only established roadways or construct and use such temporary roadways as may be authorized by the PM or DR. Do not allow load limits of vehicles to exceed the limits prescribed by appropriate regulations or law; and provide protection to road surfaces, curbs, edges of pavement, sidewalks, trees, shrubbery, sprinkler systems, drainage structures and other like existing improvements to prevent damage; and repair any damage thereto at the expense of the Contractor.

5.4.13.4 TxDOT may restrict the Contractor's entry to the site to specifically assigned entrances and routes.

5.4.14 **Ancillary / Integral Professional Services**. In selecting an architect, engineer or land surveyor, etc. to provide professional services, if any, that are required by the Plans and Specifications, do so on the basis of competitive bids but make such selection on the basis of demonstrated competence and qualifications to perform the services in the manner provided by Texas Government Code §2254.004.

5.4.15 **Notifications.** Provide written notifications to the PM or designate representative for all observations and inspections of the Work and any other required notifications set forth in the Contract Documents within the time frames specified.

5.4.16 **Continuing the Work.** Carry on the Work and adhere to the Progress Schedule during all disputes, disagreements or dispute resolution processes with TxDOT. No Work shall be delayed or postponed pending resolution of any disputes, disagreements or processes, except as TxDOT and the Contractor may agree in writing

5.4.17 **Environment.** Do not cause directly or indirectly pollution of air, soil, and water in, on, or around the Site or improvements through the release or discharge of any Hazardous Materials. At its sole cost and expense take any and all corrective action required by any applicable federal, state, county, municipal, and other laws, codes, ordinances, rules, and regulations to clean up, remove, and abate any and all soil contamination, groundwater contamination, or any other contamination of the Site caused directly or indirectly by any release or discharge of any Hazardous Materials in, on, under, and around the Site by Contractor and/or Contractor's employees, agents representatives, Subcontractors, invitees, or any other person occupying the Site or any portion thereof by, through, or under the Contractor, excluding TxDOT and its employees, agents, representatives or invitees occupying the Site or any portion thereof.

5.4.18 **Indemnity for Environmental Damages. IF THE CONTRACTOR AND/OR ANY ENTITIES OR PERSONS FOR WHOM THE CONTRACTOR IS RESPONSIBLE BRING OR DISPOSE OF ANY HAZARDOUS, TOXIC, OR OTHERWISE HARMFUL SUBSTANCES ONTO THE SITE, THE CONTRACTOR WILL INDEMNIFY, SAVE AND HOLD HARMLESS TXDOT FROM AND AGAINST ANY AND ALL CLAIMS, SUITS, CAUSES OF ACTION, LOSSES AND ALL OTHER DAMAGE AND EXPENSE (INCLUDING COST OF DEFENDING AGAINST THE AFORESAID).**

5.4.18.1 **THE CONTRACTOR'S INDEMNITY HEREUNDER INCLUDES, BUT IS NOT LIMITED TO, ANY NEGLIGENT ACT OR OMISSION OF THE CONTRACTOR AND/OR ANY ENTITIES OR PERSONS FOR WHOM THE CONTRACTOR IS RESPONSIBLE. CONTRACTOR SHALL BEAR THE COSTS FOR REMEDIATION OF ANY RESULTING ENVIRONMENTAL DAMAGES DUE TO THE ACTIVITIES OF THE CONTRACTOR, ITS SUBCONTRACTORS AND/OR ANY ENTITIES OR PERSONS FOR WHOM THE CONTRACTOR IS RESPONSIBLE. THE CONTRACTOR'S INDEMNITY AND OBLIGATIONS HEREUNDER WILL SURVIVE THE TERMINATION OF THIS CONTRACT.**

5.4.19 **Utilities.** Be responsible for, unless stated otherwise in the plans and specifications, and bear all costs to extend any required utility service to the site as called for on the plans and specifications. Provide and pay all costs for protection of infrastructure under control of any utility service provider at no additional cost to TxDOT.

5.4.20 **Separate Contracts.** Additional Contractor responsibilities when TxDOT awards separate Contracts.

5.4.20.1 TxDOT reserves the right to award other contracts in connection with other portions of the Project under these or similar contract conditions.

5.4.20.2 TxDOT reserves the right to perform operations related to the Project with TxDOT forces and shall be responsible for any activities performed under separate contract.

5.4.20.3 Under a system of separate contracts, the conditions described herein continue to apply except as may be amended by Change Order.

5.4.21 **Errors, Omissions and Negligent Acts of the Contractor, its Subcontractors and Employees.** Be responsible for errors, omissions and negligent acts of its employees, subcontractors, suppliers and their agents and employees. This shall not be limited by any tier of subcontracting/supplier or "independent" contractor status. TxDOT may, in writing, require the Contractor to remove from the Project any of its employees or Subcontractor employees that the PM or designated representative finds to be careless, incompetent, or otherwise objectionable.

5.4.22 **Indemnification of TxDOT. THE CONTRACTOR COVENANTS AND AGREES TO FULLY INDEMNIFY AND HOLD HARMLESS, TXDOT, ET AL, AS SET FORTH IN VARIOUS SECTIONS OF THE CONTRACT DOCUMENTS. IN THE EVENT THE CONTRACTOR AND TXDOT ARE FOUND JOINTLY LIABLE BY A COURT OF COMPETENT JURISDICTION, LIABILITY SHALL BE APPORTIONED COMPARATIVELY IN ACCORDANCE WITH THE LAWS OF THE STATE OF TEXAS AND WITHOUT WAIVING ANY DEFENSES OF THE PARTIES UNDER TEXAS LAW. THIS PROVISION SHALL SURVIVE THE TERMINATION OF THE CONTRACT.**

5.4.22.1 Provisions of this Indemnification are solely for the benefit of the parties hereto and TxDOT's successor or assignee, if any, and not intended to create or grant any rights, contractual or otherwise, to any other person or entity.

5.4.22.2 Contractor shall promptly advise TxDOT in writing of any claim or demand against TxDOT or the Contractor known to the Contractor related to or arising out of the Contractor's activities under this Contract.

5.4.23 **Contractor's Risk of Performance**. Except as expressly provided in the contract provisions the Contractor shall not be entitled to an increase in the Contract Sum or Contract Time and shall bear full responsibility for all risks affecting the Contractor's cost of performance.

Article 6 Historically Underutilized Business (HUB) Subcontracting Plan (if required)

6.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS**. In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

6.2 **GENERAL DESCRIPTION**. The purpose of the Historically Underutilized Business (HUB) Program is to promote equal business opportunities for economically disadvantaged persons (as defined by Tex. Gov't Code, Chapter 2161) to contract with the State of Texas. The HUB Program is applicable to TxDOT contracts relating to buildings, professional services, aviation, public transportation, private consultant services, and purchases funded entirely with State and local funds.

6.2.1 State agencies are required by statute to make a good faith effort to assist HUBs in participating in contract awards issued by the State. TxDOT's rules, Texas Administrative Code, Title 43, Part 1, Chapter 9, Subchapter D, outline TxDOT's policy to encourage outreach to and potential utilization of HUBs in subcontracting opportunities through race, ethnic and gender-neutral means. The goal of this program is to promote full and equal business opportunity for all businesses in State contracting.

6.2.2 A Contractor who contracts with the State in an amount in excess of $100,000 shall be required to make a good faith effort to award subcontracts to HUBs in accordance with the cited rules by submitting a HUB Subcontracting Plan and complying with the Subcontracting Plan after it is accepted by TxDOT and during the term of the Contract.

6.3 **COMPLIANCE WITH APPROVED HUB SUBCONTRACTING PLAN**. Comply with the HUB Program as follows.

6.3.1 Maintain and make available to TxDOT upon request business records documenting compliance with the accepted HUB Subcontracting Plan.

6.3.2 Upon receipt of payment for performance of Work, the Contractor shall submit to TxDOT a compliance report, in the format as provided by TxDOT that demonstrates Contractor's performance of the HUB Subcontracting Plan.

6.3.3 Prior to substituting a Subcontractor, promptly notify TxDOT in the event a change is required for any reason to the accepted HUB Subcontracting Plan.

6.3.4 Conduct the good faith effort activities required and provide TxDOT with necessary documentation to justify approval of a change to the approved HUB Subcontracting Plan.

6.3.5 Promptly and accurately explain and provide supplemental information to TxDOT to assist in TxDOT's investigation of the Contractor's good faith effort to fulfill the HUB Subcontracting Plan.

6.3.6 Cooperate in the execution of a Change Order or such other approval of the change in the HUB Subcontracting Plans as the Contractor and TxDOT may agree to.

6.4 **FAILURE TO DEMONSTRATE GOOD FAITH EFFORT.** Upon a determination by TxDOT the Contractor has failed to demonstrate a good faith effort to fulfill the HUB Subcontracting Plan or any Contract covenant detailed above, TxDOT may, in addition to all other remedies available to it, report the failure to perform to the Texas Procurement and Support Services (TPASS) with the Texas Comptroller of Public Accounts, and may bar the Contractor from future contracting opportunities with TxDOT.

6.5 **MONTHLY REPORTING.** Submit monthly a current HUB Subcontracting Plan (HSP) Prime Contractor Progress Assessment Report on forms downloaded from the Texas Comptroller of Public Accounts web site *www.window.state.tx.us*. This report shall include current information for all HUB and Non-HUB subcontractors and HUB suppliers.

6.6 **FINAL REPORT.** Submit monthly HUB Subcontracting Plan (HSP) Prime Contractor Progress Assessment Report documenting compliance with the HSP until all HUB and Non-HUB subcontractors and HUB suppliers have been tendered final payment and shall so designate by labeling the report form "FINAL REPORT".

Article 7 Bonds & Insurance

7.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

7.2 **CONSTRUCTION BONDS**. The Contractor is required to tender to TxDOT, prior to commencing work, performance and payment bonds, as required by Texas Government Code, Chapter 2253.

7.2.1 **Payment Bond.** A payment bond is required if the Contract Sum is in excess of $25,000. The payment bond is payable to the State, in the full amount of the Contract Sum and solely for the protection and use of payment bond beneficiaries who have a direct contractual relationship with the Contractor or supplied required materials or labor.

7.2.2 **Performance Bond**. A performance bond is required if the Contract Sum is in excess of $100,000. The Performance Bond is solely for the protection of the State, in the full amount of the Contract Sum and conditioned on the faithful performance of the Work in accordance with the Contract Documents.

7.2.3 **Surety Requirements**. Each bond shall be executed on TxDOT's form by a corporate surety or sureties authorized to do business in the State of Texas, acceptable to TxDOT and in compliance with the relevant provisions of the Texas Insurance Code. If a Surety upon a bond loses its authority to do business in the State, the Surety's underwriting limitation drops below the required bond amount or the Surety is declared bankrupt or insolvent, the Contractor shall, within fifteen (15) days after occurrence of any of the aforementioned events, furnish a replacement bond at no added cost to TxDOT. In such event the Work will be suspended until a substitute Surety acceptable to TxDOT is provided and a non-compensable time extension to the Contract will be granted for the fifteen (15) days or thirty (30) days if an acceptable Surety is not readily provided, whichever is sooner. The Contractor's inability to find an acceptable Surety within thirty (30) days will be deemed a breach of contract and TxDOT may, in its sole discretion assess liquidated damages or declare the Contract in default and terminate the Contract.

7.2.4 **Power of Attorney**. Each bond shall be accompanied by a valid Power-of- Attorney (issued by the Surety company and attached, signed and sealed with the corporate embossed seal, to the bond) authorizing the attorney in fact who signs the bond to obligate the company to the terms of the bond, and state any limits in the amount for which the attorney can issue a single bond.

7.3 **BOND INDEMNIFICATION.** The process of requiring and accepting bonds and making claims thereunder shall be conducted in compliance with Tex. Gov't Code, Chapter 2253. **IF FOR ANY REASON A STATUTORY PAYMENT OR PERFORMANCE BOND IS NOT HONORED BY THE SURETY, THE CONTRACTOR SHALL FULLY INDEMNIFY AND HOLD TXDOT HARMLESS OF AND FROM ANY COSTS, LOSSES, OBLIGATIONS OR LIABILITIES IT INCURS AS A RESULT**.

7.4 **FURNISHING BOND INFORMATION.** TxDOT shall furnish a copy of the payment bond to any qualified person who complies with Tex. Gov't Code, §2253.026.

7.5 **CLAIMS ON PAYMENT BONDS.** Claims on payment bonds must be sent directly to the Contractor and his Surety in accordance with Texas Government Code § 2253.041. All Payment Bond claimants are cautioned that no lien exists on the funds unpaid to the Contractor on such Contract, and that reliance on notices sent to TxDOT may result in loss of their rights against the Contractor and/or his Surety. TxDOT is not responsible in any manner to a claimant for collection of unpaid bills, and accepts no such responsibility because of any representation by any agent or employee.

7.6 **PERFORMANCE BOND SURETY'S OBLIGATION.** The Surety for the Performance Bond, if required, shall undertake the obligations of the Contractor in the event of the Contractor's failure to perform pursuant to the Contract or in the event of Contractor's insolvency or bankruptcy.

7.7 **INSURANCE REQUIREMENTS.** Carry insurance in the types and amounts indicated in *Article 3* and as otherwise required by the Contract Documents for the duration of the Contract unless specifically stated otherwise. Regardless of approval and issuance of Final Acceptance, the Contract is not deemed fully performed by the Contractor and closed until the expiration of all warranty periods. TxDOT shall not be deemed or construed to have assessed the risk that may be applicable to the Contractor under this Contract. The Contractor shall assess its own risks and if it deems appropriate or prudent or both, maintain higher limits or broader coverages or both at no additional cost to TxDOT.

7.7.1 The required insurance shall include coverage for TxDOT's property in the care, custody and control of Contractor, its subcontractors and its agents prior to construction, during construction and during the warranty period.

7.7.2 The required insurance shall be evidenced by delivery of a TxDOT certificate of insurance executed by the insurer or its authorized agent during contract execution

7.7.3 **Policy Expiration.** Provide an updated TxDOT certificate of insurance prior to expiration. In the event the Contractor fails to maintain the required insurance all work shall stop until TxDOT receives an acceptable certificate of insurance. Contract Time charges will not be suspended in the event work is stopped due to the failure of the Contractor to maintain the required insurance. Acceptance of the insurance certificate by TxDOT shall not relieve or decrease the liability of the Contractor.

7.7.4 Without limiting any of the other obligations or liabilities of the Contractor, the Contractor shall require each Subcontractor performing work under the Contract to maintain during the term of the Contract, the same required minimum insurance including the required provisions and additional policy conditions unless specifically stated otherwise. The Contractor shall obtain and monitor the certificates of insurance from each Subcontractor in order to assure compliance with the insurance requirements. As an alternative, the Contractor may include its Subcontractors as additional insured on the Contractor's coverage. In such event the Contractor's certificate of insurance shall note that Subcontractors are included as additional insured.

7.7.5 Coverage shall be written on an occurrence basis by companies authorized and admitted to do business in the State of Texas and acceptable to TxDOT unless specifically stated otherwise.

7.7.6 Builder's Risk Insurance shall be dedicated project insurance and specific to this Contract.

7.7.7 All deductibles shall be the sole responsibility of the Contractor.

7.7.8 The insurance requirements specified do not reduce the liability the Contractor has assumed in the indemnification/hold harmless provisions of the Contract.

7.7.9 Upon written request, TxDOT, and/or its agents, shall be entitled to receive without expense, copies of the required policies and endorsements.

7.8 **REQUIRED POLICY CLAUSES**. Unless stated otherwise policies must include the following clauses:

7.8.1 Notice shall be delivered to TxDOT in accordance with the policy provisions should this insurance policy be cancelled before the expiration date thereof.

7.8.2 This insurance policy shall not be materially changed or non-renewed without notice being delivered to TxDOT in accordance with the policy provisions.

7.8.3 It is agreed that the Contractor's insurance shall be deemed primary with respect to any insurance or self-insurance carried by the State agency for liability arising out of operations and activities under the Contract with TxDOT.

7.8.4 TxDOT, its officials, directors, employees, representatives, and volunteers are added as additional insured as respects operations and activities of, or on behalf of, the named insured performed under Contract with TxDOT. This requirement is not applicable to the workers' compensation policy.

7.9 **WORKER'S COMPENSATION INSURANCE.**

7.9.1 Limits of liability: not less than statutory requirements by the Texas Workers' Compensation Act.

7.9.2 Worker's Compensation Insurance coverage must meet the statutory requirements of the Texas Labor Code, §401.011(44) and specific to construction projects for public entities as required by the Texas Labor Code, §406.096.

7.9.3 The Contractor shall provide TxDOT with a current Workers' Compensation Insurance coverage certificate for each Subcontractor and all sub-tier subcontractors employed on the project in accordance with Texas Labor Code §406 .096(b).

7.9.4 The policy shall be endorsed with a Waiver of Subrogation in favor of TxDOT.

7.10 **COMMERCIAL GENERAL LIABILITY INSURANCE.**

7.10.1 Limits of liability: not less than $600,000 for each occurrence.

7.10.2 Coverage shall include liability arising from products/completed operations, liability arising from explosion, collapse, underground property damage, damage to the work, and liability assumed under contract.

7.11. **BUSINESS AUTOMOBILE LIABILITY INSURANCE.**

7.11.1 Limits of liability: not less than $600,000 combined single limit.

7.11.2 If coverage is specified separately, limits of liability not less than:

7.11.2.1 Bodily Injury: $250,000 each person.

7.11.2.2 Property Damage: $500,000 each occurrence.

7.11.3 Coverage extends to owned, hired and non-owned vehicles assigned to or used in performance of the Contract.

7.12 * BUILDER'S RISK INSURANCE.

* For renovation projects or projects that involve portions of work contained within an existing structure refer to Special Condition, if any, for additional Builder's Risk Insurance requirements.

7.12.1 Limits of liability: not less than 100% of Contract Sum.

7.12.2. Policy shall be an all risk policy. Coverage shall be all risk including, but not limited to, Fire, Wind, Lightning, Water, Hail, Smoke, Theft, Vandalism, Malicious Mischief, Collapse, Flood, Earthquake, Hurricane, Tornado, and damage resulting from faulty workmanship, materials, or design provided directly or indirectly by the Contractor. Coverage shall include transit and storage of materials and equipment in an amount sufficient to protect property being transported or stored.

7.12.3. The policy shall have endorsements as follows.

7.12.3.1. TxDOT shall be named as Loss Payee under the Loss Payable clause.

7.12.3.2. This insurance shall be specific as to coverage and not considered as contributing insurance with any permanent insurance maintained on the property.

7.12.3.3. This insurance shall not contain an occupancy clause suspending or reducing coverage should TxDOT occupy, or begin beneficial occupancy before TxDOT has issued the certificate of Final Completion for the project.

7.13 SPECIAL INSURANCE COVERAGE.

7.13.1. **Asbestos Abatement Liability Insurance**. If the Contract Documents include work requiring the encapsulation, removal, handling, storage, transportation, and disposal of asbestos containing materials by the Contractor, its subcontractors or agents, the Contractor shall carry insurance providing coverage for any liability arising from such activities. In lieu of the Contractor carrying the aforementioned insurance the Contractor may retain the services of an asbestos abatement contractor with a current asbestos abatement contractor license issued by the Texas Department of State Health Services (TDSHS) and the services of an asbestos transporter with a current asbestos transporter license issued by TDSHS to provide the required services.

7.13.2. The liability insurance for asbestos related work required by the Texas Department of State Health Services must be in force in order to perform any asbestos related work.

Article 8 Contract Documents

8.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

8.2 **DRAWINGS AND SPECIFICATIONS**

8.2.1 **Copies Furnished.** Contractor will be furnished, a digital set of Drawings and Specifications and any Addenda issued prior to or at the pre-construction conference.

8.2.2 **Ownership of Plans and Specifications.** All Plans, Specifications and copies thereof furnished by TxDOT are, and shall remain, TxDOT's intellectual property. These documents are not to be used on any other project, and shall be returned to TxDOT, upon request, following completion of the Work.

8.2.3 **Interrelation of Documents.** The Contract Documents as referenced in the Contract between TxDOT and the Contractor are complimentary; and, what is required by one, shall be as binding as if required by all.

8.2.4 **Resolution of Conflicts in Documents.** In the event of a conflict between and/or within the Contract Documents, the higher quality, greater quantity, more restrictive, and/or more expensive requirement shall be the basis of Contractor pricing, and the Contractor shall notify the PM or designated representative for resolution of the issue prior to executing the Work in question.

8.2.5 **Contractor's Duty to Review Contract Documents.** In order to facilitate its responsibilities for completion of the Work in accordance with and as reasonably inferable from the Contract Documents, prior to pricing or commencing the Work, the Contractor shall examine and compare the Contract Documents, information furnished by TxDOT, relevant field measurements made by the Contractor and any visible or reasonably anticipated conditions at the site affecting the Work. This duty extends throughout the construction phase prior to commencing each particular work activity and/or system installation.

8.2.6 **Errors and Omissions in Drawings and Specifications.**

8.2.6.1 Promptly report to the PM or designated representative the discovery of any apparent error, omission or inconsistency in the Contract Documents prior to execution of the Work.

8.2.6.2 Contractor has no liability for design errors and omissions unless the Contractor knowingly failed to report a recognized problem to TxDOT or the Contractor, its subcontractors, or agents provided the design for the element of Work. Should the Contractor fail to perform the examination and reporting obligations of these provisions, the Contractor is responsible for avoidable costs, direct, and/or consequential damages.

8.2.6.3 It is recognized that the Contractor is not acting in the capacity of a licensed design professional, unless the Contractor, its subcontractors or agent provide the design for any element of the Work requiring the services of a licensed design professional.

8.2.6.4 When the Contractor, its subcontractors or agents provide the design for any element of the Work requiring the services of a licensed design professional the Contractor has responsibility for discrepancies, errors, and omissions in the drawings and specifications provided for that element of the Work.

8.3 **REQUIREMENTS FOR RECORD DOCUMENTS.** Contractor shall maintain at the Site one copy of all Drawings, Specifications, addenda, approved Submittals, Contract modifications, and all Project correspondence; keep current and maintain Drawings and Specifications in good order with postings and markings to record actual conditions of Work and show and reference all changes made during construction; and provide PM or designated representative access to these documents.

8.3.1 Failure to maintain such records constitutes cause for denial of a progress payment otherwise due.

8.3.2 Prior to requesting Substantial Completion Inspection Contractor shall furnish the PM or designated representative a complete legible set (a legible digital scan is acceptable) of the marked up "As-Constructed" set of plans and specifications maintained at the site. Concurrently with furnishing these record drawings, the Contractor shall furnish a preliminary digital copy of each operating and maintenance manual (O&M) required by the Contract Documents, for review by the PM or designated representative.

8.3.2.1 Once determined acceptable, Contractor shall provide one (1) digital set of operating and maintenance manuals, approved submittals, and other record documents as required elsewhere in the Contract Documents. Submission and acceptance of these documents is a condition for the issuance of the Certificate of Substantial Completion by the PM. Any "As-Built" modifications to approved shop drawings which were prepared and issued under the seal of a licensed/registered professional must be reviewed and reissued under the seal of the licensed/registered professional of record.

Article 9 Safety

9.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

9.2 **GENERAL.** It is the duty and responsibility of the Contractor and all of its Subcontractors to be familiar with, enforce and comply with all requirements of Public Law 91-596, 29 U.S.C. §§651 et. seq., the Occupational Safety and Health Act of 1970, (OSHA) and all amendments thereto. Contractor and all of its Subcontractors shall comply with all applicable laws and regulations of any public body having jurisdiction for safety of persons or property to protect them from damage, injury or loss and erect and maintain all necessary safeguards for such safety and protection.

9.3 **NOTICES.** Contractor shall provide notices as follows:

9.3.1 Notify owners of adjacent property including those that own or operate utility services and/or underground facilities, and utility owners, when prosecution of the Work may in any way affect them or their facilities, and cooperate with them in the protection, removal, relocation and replacement, and access to their facilities and/or utilities.

9.3.2 Coordinate the exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the site in connection with laws and regulations. Maintain a complete file of MSDS for all materials in use on site throughout the construction phase and make such file available to TxDOT and its agents as requested.

9.4 **EMERGENCIES.** In any emergency affecting the safety of persons or property, the Contractor shall act to minimize, mitigate, and prevent threatened damage, injury or loss.

9.4.1 Contractor shall have its authorized agents respond immediately upon call at any time of day or night when circumstances warrant the presence of Contractor to protect the Work or adjacent property from damage or to take such action pertaining to the Work as may be necessary to provide for the safety of the public.

9.4.2 Give the PM or designated representative prompt notice of all such events.

9.4.3 Should the Contractor fail to respond, TxDOT is authorized to direct other forces to take action as necessary and TxDOT may deduct any cost of remedial action from funds otherwise due the Contractor.

9.4.4 If the Contractor believes that any changes in the Work or variations from Contract Documents have been caused by its emergency response, promptly notify the PM, DR and A/E in writing within 72 hours of the emergency response event detailing the event, actions taken and changes in the Work.

9.5 **INJURIES.** In the event of an incident or accident involving outside medical care for an individual on or near the Work, notify the PM or designated representative and other parties as may be directed within twenty-four (24) hours of the event and provide the PM or designated representative an incident report if so requested.

9.5.1 Record the location of the event and the circumstances surrounding it, by using photography or other means, and gather witness statements and other documentation which describes the event.

9.5.2 Supply the PM, DR and A/E with an incident report no later than 36 hours after the occurrence of the event. In the event of a catastrophic incident (one fatality or a worker hospitalized), barricade and leave intact the scene of the incident until all investigations are complete. A full set of incident investigation documents, including facts, finding of cause, and remedial plans shall be provided within one week after occurrence, unless otherwise directed by legal counsel. Contractor shall provide the PM with written notification within one week of such catastrophic event and submit a full report.

9.6 **ENVIRONMENTAL SAFETY.** Upon encountering any potentially hazardous material, or other materials potentially contaminated by hazardous material, Contractor shall immediately stop work activities impacted by the discovery, secure the affected area, and notify the PM or designated representative immediately.

9.6.1 Contractor shall bind all Subcontractors to the same duty.

9.6.2 Upon receiving notice of previously unknown hazardous material, the PM will promptly engage qualified experts to make such investigations and conduct such tests as may be reasonably necessary to determine the existence or extent of any environmental hazard. As soon as possible upon completion of this investigation, the PM will issue a written report to the Contractor identifying the material(s) found and indicate any necessary steps to be taken to treat, handle, transport or dispose of the material.

9.6.3 TxDOT may hire third-party contractors to perform any or all such steps.

9.6.4 Should compliance with the PM's instructions result in an increase in the Contractor's cost of performance, or delay the Work, TxDOT will make an equitable adjustment to the Contract price and/or the time of completion, and modify the Contract in writing accordingly in accordance with the provisions of the Contract.

9.6.5 If the hazardous material event is the result of a release or discharge of Hazardous Materials by the Contractor directly or indirectly through any employees, agents, representatives, Subcontractors, invitees or any other persons occupying the Site or any portion thereof by, through or under the Contractor, the Contractor at its sole cost and expense, shall take any and all corrective action required by any applicable federal, state, county, municipal, and other laws, codes, ordinances, rules, and regulations to report, clean up, remove, and abate any and all soil contamination, groundwater contamination, or any other contamination of the Site caused directly or indirectly by any release or discharge of any Hazardous Materials.

9.6.6 **Environmental Quality**. The Contract shall prevent pollution of air, soil, and water in, on, under or around the Project Site. The Contractor, at its sole cost and expense shall take any and all corrective actions deemed necessary or desirable by TxDOT, and as required by any applicable federal, state, county, municipal, and other laws, codes, ordinances, rules and regulations to clean, remove and abate any and all such contamination of the air, soil, and water in, on under or around the Project Site or adjacent lands caused directly or indirectly by any release or discharge of any hazardous, toxic, or otherwise harmful substances at the Project Site by the Contractor and/or any entities or persons for whom the Contractor is responsible.

9.7 **INDEMNITY FOR ENVIRONMENTAL DAMAGES. IF THE CONTRACTOR AND/OR ANY ENTITIES OR PERSONS FOR WHOM THE CONTRACTOR IS RESPONSIBLE BRING OR DISPOSE OF ANY HAZARDOUS, TOXIC, OR OTHERWISE HARMFUL SUBSTANCES ONTO THE SITE, THE CONTRACTOR WILL INDEMNIFY, SAVE AND HOLD HARMLESS TXDOT FROM AND AGAINST ANY AND ALL CLAIMS, SUITS, CAUSES OF ACTION, LOSSES AND ALL OTHER DAMAGE AND EXPENSE (INCLUDING COST OF DEFENDING AGAINST THE AFORESAID).**

9.7.1 **THE CONTRACTOR'S INDEMNITY HEREUNDER INCLUDES, BUT IS NOT LIMITED TO, ANY NEGLIGENT ACT OR OMISSION OF THE CONTRACTOR AND/OR ANY ENTITIES OR PERSONS FOR WHOM THE CONTRACTOR IS RESPONSIBLE. CONTRACTOR SHALL BEAR THE COSTS FOR REMEDIATION OF ANY RESULTING ENVIRONMENTAL DAMAGES DUE TO THE ACTIVITIES OF THE CONTRACTOR, ITS SUBCONTRACTORS AND/OR ANY ENTITIES OR PERSONS FOR WHOM THE CONTRACTOR IS RESPONSIBLE. THE CONTRACTOR'S INDEMNITY AND OBLIGATIONS HEREUNDER WILL SURVIVE THE TERMINATION OF THIS CONTRACT.**

9.8 **TRENCHING SAFETY.** When the project requires excavation which either exceeds a depth of five feet, or results in any worker's upper body being positioned below grade level, the Contractor is required to submit a trenching plan to the PM prior to commencing trenching operations providing the necessary protection to comply with the most current version of OSHA Standards and Interpretations, 29 CRF 1926, Subpart P, "Excavations." The plan is required to be prepared and sealed by a professional engineer registered in the State of Texas, and employed by the Contractor.

9.9 **INDEMNIFICATION OF TXDOT. THE CONTRACTOR SHALL FULLY INDEMNIFY, SAVE AND HOLD HARMLESS TXDOT OF AND FROM ANY COSTS, LOSSES, DAMAGES OR LIABILITIES RESULTING FROM ITS FAILURE, OR THE FAILURE OF THE CONTRACTORS AND/OR SUBCONTRACTORS, TO COMPLY STRICTLY WITH THESE PROVISIONS. CONTRACTOR SHALL BEAR THE COSTS FOR ANY DAMAGES DUE TO THE ACTIVITIES OF THE CONTRACTORS, ITS SUBCONTRACTORS AND/OR ANY ENTITIES OR PERSONS FOR WHOM THE CONTRACTOR IS RESPONSIBLE. THIS PROVISION SHALL SURVIVE THE TERMINATION OF THE CONTRACT.**

Article 10 Quality Control

10.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

10.2 **MATERIALS & WORKMANSHIP.** Execute Work in a good and workmanlike matter in accordance with the Contract Documents. If required by a Special Condition the Contractor shall develop and provide a Quality Control Plan specific to this project and acceptable to TxDOT. Where Contract Documents do not specify quality standards, the Contractor shall complete and construct all Work in compliance with generally accepted construction industry standards. Unless otherwise specified, the Contractor shall incorporate all new materials and equipment into the Work under the Contract.

10.3 **TESTING.**

10.3.1 **Contractor Testing.** Contractor is responsible for coordinating and paying for all routine and special tests required to confirm compliance with quality and performance requirement of the Contract Documents. This "quality control" testing shall include any particular testing required by the Plans and Specifications and the following general tests:

10.3.1.1 Any test of basic material or fabricated equipment included as part of a submittal for a required item in order to establish compliance with the Contract Documents.

10.3.1.2 Any test of basic material or fabricated equipment offered as a substitute for a specified item on which a test may be required in order to establish compliance with the Contract Documents.

10.3.1.3 Routine, preliminary, start-up, pre-functional and operational testing of building equipment and systems as necessary to confirm operational compliance with requirements of the Contract Documents.

10.3.1.4 All subsequent tests on original or replaced materials conducted as a result of prior testing failure.

10.3.2 **TxDOT Testing.** TxDOT reserves the right to subject materials and systems incorporated into the Project to routine tests as may be specified or as deemed necessary by the PM or designated representative to ensure compliance with the quality and/or performance requirements of the Contract Documents and/or with laws, ordinances, rules, regulations and/or orders of any public authority having jurisdiction. The results of such "quality assurance" testing will be provided to the Contractor and, to the extent provided, the Contractor may rely on findings.

10.3.2.1 All testing shall be performed in accordance with standard test procedures by an accredited laboratory, a TxDOT testing laboratory, or special consultant as appropriate, acceptable to TxDOT. Results of all tests shall be provided promptly to the PM and the Contractor.

10.3.3 **Non-Compliance (Test Results).** Should any of the tests indicate that a material and/or system does not comply with the contract requirements, the burden of proof remains with the Contractor, subject to:

10.3.3.1 Contractor selection and submission of the laboratory for TxDOT acceptance.

10.3.3.2 Acceptance by TxDOT of the quality and nature of tests.

10.3.3.3 All tests or bids or both be taken in the presence of the PM or designated representative.

10.3.3.4 If tests confirm that the material/systems, indicated by TxDOT testing to not be in compliance with Contract Documents, are in compliance with Contract Documents, TxDOT will pay the Contractor the cost of the test.

10.3.3.5 If tests reveal noncompliance, the Contractor will pay those laboratory fees and costs of that particular test and all future tests, of that failing Work, necessary to eventually confirm compliance with Contract Documents.

10.3.3.6 Proof of noncompliance with the Contract Documents will make the Contractor liable for any corrective action which the PM determines appropriate, including complete removal and replacement of non-compliant work or material at no additional cost to TxDOT.

10.3.4 **Notice of Testing.** Contractor shall give the PM or designated representative twenty-four (24) hours written notice of its readiness and the date arranged so the PM or their designated representative may observe such testing or gathering of test samples.

10.3.5 **Test Samples.** Contractor is responsible for providing samples of sufficient size for test purposes and for coordinating such tests with their Work Progress Schedule to avoid delay

10.3.6 **Covering up Work.** If Contractor covers up any Work without providing TxDOT an opportunity to observe the testing, the Contractor shall, if requested by PM, uncover and recover the work at Contractor's expense.

10.4 **INSPECTIONS**.

10.4.1 **Access.** Contractor shall provide sufficient, safe, and proper facilities, including equipment as necessary for safe access, at all reasonable times for observation or inspection or both of the Work by TxDOT and its agents.

10.4.2 **Notice of Inspection.** Contractor shall provide the PM or designated representative written notice five (5) calendar days or as otherwise mutually agreed, prior to the anticipated need for a cover up inspection. Should the PM or designated representative fail to make the necessary inspection within the agreed period, the Contractor may proceed with cover up Work, but is not relieved of responsibility for Work to comply with requirements of the Contract Documents.

10.4.3 **Covering Up Work.** If the Contractor covers up any Work without providing TxDOT an opportunity to inspect, the Contractor shall, if requested by PM or designated representative, uncover and recover the work at Contractor's expense.

10.4.3.1 Should corrections of the Work be required, the Contractor shall not cover up corrected Work until TxDOT indicates review.

10.5 DEFICIENCIES IN THE WORK. TxDOT reserves the right to withhold from funds remaining unpaid under the Contract amounts required to pay the costs of, but not limited to, the following:

10.5.1 Special site visits required to re-examine a cited deficiency which has not been corrected after a total of two (2) visits. The provisions for comprehensive inspections set forth in *Article 10.4* shall govern those inspections.

10.5.2 Special monitoring to ensure compliance with the Contract Documents due to non-performance or poor workmanship.

10.5.3 Assessments of potential damage, resulting from failure of the Contractor to protect the Work.

10.6 SUBMITTALS.

10.6.1 **Contractor's Submittals**. Contractor shall submit in accordance with the Project Schedule and in orderly sequence all Shop Drawings, Samples, or other information required by the Contract Documents, or subsequently required by Change Order. Prior to submitting, Contractor shall review each submittal for compliance with Contract Documents and certify compliance by review stamp affixed to each copy. Submittal data presented without the Contractor's certification will be returned without review or comment, and any delay resulting from such certification is the Contractor's responsibility.

10.6.1.1 Within twenty-one (21) calendar days of issuance of the Authorization to Begin Work letter, unless otherwise modified by the PM in writing, the Contractor shall submit to the PM, a submittal schedule/register, organized by specification section, listing all items to be furnished for review by the PM or designated representative. The list shall include shop drawings, manufacturer's literature, certificates of compliance, materials samples, materials colors, guarantees, and all other items identified throughout the specifications.

10.6.1.2 Contractor shall indicate the type of item, contract requirements reference, and Contractor's scheduled dates for submitting the item along with the requested dates for review answers from the PM. Reference Special Conditions for any additional item tracking/reporting information required to be included in the submittal schedule/register. The submittal register shall be updated at least monthly with actual reviewed dates. Contractor shall schedule submissions at least forty (40) days before reviewed submittal will be required. Contractor shall allow a minimum of twenty-one (21) calendar day duration after receipt by the PM for review of each submittal. If re-submittal is required, the Contractor shall allow a minimum of fifteen (15) calendar days for review. Contractor shall submit the updated submittal register with each request for progress payment.

TxDOT may establish alternate routine review procedures and schedules for submittals at the preconstruction conference, elsewhere in the Contract Documents, or as otherwise necessary.

10.6.1.3 Contractor shall coordinate the submittal register with the Work Progress Schedule. Contractor shall not schedule Work requiring a submittal to begin prior to scheduling review of the related submittal. Contractor shall revise and/or update both schedules monthly to ensure consistency and current project data. Provide to the PM the updated submittal register and schedule with each application for progress payment. Refer to requirements for the Work Progress Schedule for inclusion of procurement activities therein, if any; and schedule for inclusion of procurement activities therein, if any. The submittal register shall identify dates submitted and returned and shall be used to confirm status and disposition of particular items submitted, including review or other action taken and other information not conveniently tracked through the Work Progress Schedule.

10.6.1.4 By submitting Shop Drawings, Samples or other required information, the Contractor represents and certifies that they have determined and verified all applicable field measurements, field construction criteria, materials, catalog numbers and similar data, have been determined and verified and that each Shop Drawing and Sample has been checked and coordinated with the requirements of the Work and the Contract Documents.

10.6.2 **Review of Submittals.** PM or designated representative's review are only for conformance with the design concept and the information provided in the Contract Documents. Responses to submittals will be in writing. The review of a separate item does not indicate review of an assembly in which the item functions. The review of a submittal does not relieve the Contractor of responsibility for any deviation from the requirements of the Contract unless the Contractor informs the PM or designated representative of such deviation in a clear, conspicuous, and written manner on the submittal transmittal and at the time of submission, and obtains TxDOT's written specific acceptance of the particular deviation.

10.6.3 **Correction and Resubmission.** Make any corrections required to a submittal and resubmit the required number of corrected copies promptly so as to avoid delay of submittal review. Contractor shall direct attention in writing to the PM or designated representative, when applicable, to any new revisions other than the corrections requested on previous submissions.

10.6.4 **Limits on Shop Drawing Review.** Do not commence any Work requiring a submittal before review of the submittal. Contractor shall construct all such work in accordance with reviewed submittals and the Contract Documents. Review of Shop Drawings and Samples is not authorization to Contractor to perform extra work or changed work unless authorized through a Change Order. The PM or designated representative's review, if any, does not relieve Contractor from responsibility for defects in the Work resulting from errors or omissions of any kind on the submittal, regardless of any review action.

10.6.5 **No Substitutions without Review.** PM or designated representative may receive and consider the Contractor's request for substitution when the Contractor agrees to reimburse TxDOT for direct and indirect review costs and satisfies *10.6.5.1*, *10.6.5.2*, and *10.6.5.3* in combination with one or more of the items in *10.6.5.4* through *10.6.5.11* of the following conditions, as determined by TxDOT. If the Contractor does not satisfy these conditions, the PM or designated representative will return the request without action except to record noncompliance with these requirements. TxDOT will not consider the request if the Contractor cannot provide the product or method because of failure to pursue the Work promptly or coordinate activities properly.

10.6.5.1 Contract Documents do not require extensive revisions.

10.6.5.2 Proposed changes are in keeping with the general intent of the Contract Documents and the design intent and do not result in an increase in cost to TxDOT.

10.6.5.3 Request is timely, fully documented, and properly submitted.

10.6.5.4 Contractor cannot provide the specified product, assembly or method of construction within the Contract Time.

10.6.5.5 Request directly relates to an "or-equal" clause or similar language in the Contract Documents.

10.6.5.6 Request directly relates to a "product design standard" or "performance standard" clause in the Contract Documents.

10.6.5.7 Requested substitution offers TxDOT a substantial advantage in cost, time, energy conservation or other considerations, after deducting additional responsibilities TxDOT must assume.

10.6.5.8 Specified product or method of construction cannot receive necessary review by an authority having jurisdiction, and the PM or designated representative can review the request.

10.6.5.9 Contractor cannot provide the specified product, assembly or method of construction in a manner that is compatible with other materials and where Contractor certifies that the substitution will overcome the incompatibility.

10.6.5.10 Contractor cannot coordinate the specified product, assembly or method of construction with other materials and Contractor certifies they can coordinate the proposed substitution.

10.6.5.11 Specified product, assembly or method of construction cannot provide a warranty required by the Contract Documents and Contractor certifies that the proposed substitution provides the required warranty.

10.6.6 **Unauthorized Substitutions at Contractor's Risk.** Contractor is financially responsible for any additional costs or delays resulting from using materials, equipment or fixtures other than those specified. Contractor shall reimburse TxDOT for any increased design or contract administration costs resulting from any unauthorized substitutions.

10.7 **FIELD MOCK-UP**.

10.7.7 Mock-ups shall be constructed prior to commencement of a specified scope of work to confirm acceptable workmanship.

10.7.7.1 As a minimum, field mock-ups shall be as identified throughout the Contract Documents. Mockups for systems not part of the project scope shall not be required.

10.7.7.2 Mock-ups may be incorporated into the Work if allowed by the Contract Documents and if acceptable to the PM. If mock-ups are freestanding, they shall remain in place until otherwise directed by the PM.

10.7.7.3 Include field mock-ups in their Work Progress Schedule and shall notify the PM and A/E of readiness for review sufficiently in advance to coordinate review without delay.

10.8 **INSPECTION DURING CONSTRUCTION**.

10.8.8 Provide sufficient, safe, and proper facilities, including equipment as necessary for safe access, at all reasonable times for observation and/or inspection of the Work by TxDOT and its agents.

10.8.9 Do not cover up any work with finishing materials or other building components prior to providing TxDOT and its agents an opportunity to perform an inspection of the Work.

10.8.9.1 Should corrections of the Work be required for approval, do not cover up corrected Work until TxDOT indicates approval.

10.8.9.2 Provide notification of at least five (5) calendar days or as otherwise mutually agreed, to the PM of the anticipated need for a cover up inspection. Should the PM fail to make the necessary inspection within the agreed period, the Contractor may proceed with cover up Work, but is not relieved of responsibility for Work to comply with requirements of the Contract Documents.

10.9 **BUY AMERICA.** Comply with the latest provisions of Buy America as listed at 23 CFR 635.410. Use steel or iron materials manufactured in the United States except when:

10.9.1 Cost of materials, including delivery, does not exceed 0.1% of the total Contract cost or $2,500, whichever is greater;

10.9.2 Contract contains an alternate item for a foreign source steel or iron product and the Contract is awarded based on the alternate item;

10.9.3 The materials are temporarily installed.

Provide a notarized original of FORM D-9-USA-1 (Department Form 1818) with the proper attachments for verification of compliance.

10.10 **BUY TEXAS.** Buy materials produced in Texas when the materials are available at a comparable price and in a comparable period of time. Provide documentation of purchases or a description of good-faith efforts on request.

Article 11 Construction Schedules

11.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

11.2 **WORK PROGRESS SCHEDULE.** Refer to any Special Condition, any Division 1 Specifications, or preconstruction conference meeting minutes for any alternate or additional schedule requirements. Unless indicated otherwise in those documents, submit the initial Work Progress Schedule for the Work in relation to the entire Project not later than twenty-one (21) days after the date of the Authorization to Begin Work Letter to the PM or designated representative. Unless otherwise indicated or directed in writing the Work Progress Schedule shall be a computerized Critical Path Method (CPM) with full reporting capability and in a format and in sufficient detail acceptable to the PM or designated representative. The initial schedule shall indicate the dates for starting and completing the various aspects required to complete the Work, including mobilization, procurement, installation, testing, inspection, and acceptance of all the Work of the Contract. The schedule, when accepted by TxDOT, shall be the Baseline Schedule for comparison to actual conditions throughout the contract duration. Failure of the Contractor to provide a Work Progress Schedule as set forth above will be considered sufficient cause for TxDOT to order the work under the Contract to be stopped without suspension of Contract time charges.

11.2.1 **Schedule Requirements.** Submit in an electronic format acceptable to TxDOT the Work Progress Schedule accepted by TxDOT reflecting accurate and reliable representations of the planned progress of the Work, the Work performed to date, if any, and the Contractor's actual plans for its completion. organize and provide adequate detail so the Schedule is capable of measuring and forecasting the effect of delaying events on completed and uncompleted activities.

11.2.1.1 Re-submit initial Schedule as required to address review comments from the PM or designated representative until such Schedule is accepted by TxDOT as the Baseline Schedule.

11.2.1.2 Submittal of a schedule, schedule revision or schedule update constitutes the Contractor's representation to TxDOT of the accurate depiction of all progress to date and that the Contractor will follow the schedule as submitted in performing the Work.

11.2.2 **Schedule Updates.** Update the Work Progress Schedule and the Submittal Schedule not less than monthly to reflect progress to date and current plans for completing the Work, and submit an electronic copy of the update to the PM or designated representative. TxDOT has no duty to make progress payments unless accompanied by the updated Work Progress Schedule. Show the anticipated date of completion reflecting all extensions of time granted through Change Order as of the date of the update. Contractor may revise the Progress Schedule logic only with TxDOT's concurrence when, in the Contractor's judgment, it becomes necessary for the management of the Work. Identify all proposed changes to schedule logic to the PM or designated representative via an Executive Summary accompanying the updated schedule for review prior to implementation of revisions.

11.2.3 **Effect of Work Progress Schedule.** The Work Progress Schedule is for the Contractor's use in managing the Work. Submittal of the Schedule, and successive updates or revisions, is for the information of TxDOT and to demonstrate that the Contractor has complied with requirements for planning the Work. TxDOT's acceptance of a schedule, schedule update or revision constitutes TxDOT's agreement to coordinate its own activities with the Contractor's activities as shown on the schedule.

11.2.3.1 Acceptance of a Work Progress Schedule update or revision indicating early or late completion does not constitute TxDOT's consent or approval, alter the terms of the Contract, constitute a change in terms of the contract, or waive either the Contractor's responsibility for timely completion or TxDOT's right to damages for the Contractor's failure to do so. Change Orders are the only method of modifying the completion Date(s) and Contract Time.

11.3 **OWNERSHIP OF FLOAT.** Float time contained in the Work Progress Schedule is not for the exclusive benefit of the Contractor or TxDOT, but belongs to the Project and may be consumed by either party as needed on a first-used basis.

11.4 **FORCE MAJEURE.** Force Majeure shall mean any delays, hindrances, or suspensions of the Work for (1) unexpected natural events (sometimes called "acts of God"); (2) strikes, labor disputes, labor shortages, or material shortages outside of the Contractor's reasonable control; (3) acts of public enemy; (4) riots; (5) epidemics disabling the labor force; (6) landslides; (7) earthquakes affecting the Project; (8) fires; (9) hurricanes (10) tornadoes; (11) partial or entire failure of public utilities affecting the Project; (12) delays associated with concealed, unknown, or unforeseen conditions associated with the Property which with reasonable diligence could not

have been discovered by the Contractor prior to execution of this Contract; (13) delay in issuing any governmental or regulatory permit, license or approval necessary or required for implementation of the Project which with reasonable diligence could not have been avoided by the Contractor; (14) any other similar cause or event not reasonably within the Contractor's / subcontractor's control and not resulting from their errors, omissions or negligent acts.

11.4.1 The Contractor's relief in the event of such Force Majeure delays, hindrances, or suspensions of the Work is the time impact to the critical path as determined by analysis of the Contractor's schedule. Upon review and concurrence of the time impact documentation by the PM a non-compensable time extension to the Contract Time will be issued by Change Order. When such delays, hindrances, or suspensions are the result of the conditions defined under ***Article 17.6***, Termination by Contractor, the Contractor's relief will be governed by the conditions of ***Article 14*** should the Contract be terminated under ***Article 17***.

Article 12 Contract Time

12.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

12.2 **CONTRACT TIME. TIME IS AN ESSENTIAL ELEMENT OF THE CONTRACT**. Contract Time can be modified only by Change Order. Failure to achieve Substantial Completion within the Contract Time will cause damage to TxDOT and subject the Contractor to Liquidated Damages as provided in the Contract Documents.

12.3 **AUTHORIZATION TO BEGIN WORK.** TxDOT will issue an Authorization to Begin Work Letter authorizing the Contractor to begin construction in accordance with the provisions of the Contract and establishing the date stated in the Contract for completion of the Work, or establishing the beginning date time charges will commence for computing Contract Time for completion of the Work.

12.4 **COMPLETION OF WORK.** Contractor is accountable for completing the Work in the time stated in the Contract, or as otherwise amended by Change Order.

12.4.1 If, in the judgment of TxDOT, the work is behind schedule and the rate of placement of work is inadequate to regain scheduled progress to insure timely completion of the entire work or a separable portion thereof, TxDOT shall so notify the Contractor and Surety, if any.

12.4.2 Within ten (10) calendar days after such notice from the PM or designated representative, Contractor shall notify the PM in writing of the specific measures taken and/or planned to facilitate timely completion of the entire work or a separable portion thereof and include an estimate as to the date of scheduled progress recovery and an updated Work Progress Schedule illustrating the Contractor's plan for achieving timely completion of the project.

12.5 **COMPUTATION OF CONTRACT TIME FOR COMPLETION.** TxDOT will furnish the Contractor a monthly statement on prescribed forms, showing the number of calendar days charged during the month, total number of days allowed in the Contract and the number of days remaining under the Contract. The Contractor will be allowed ten (10) calendar days in which to protest the correctness of the statement with supporting documentation, otherwise the statement will stand.

12.6 **MODIFICATION OF THE CONTRACT TIME.**

12.6.1 **Extension of Time.** Delays and extension of time as hereinafter described are valid only if executed in accordance with provisions set forth in *Article 14*. All extensions of time will be granted in calendar days. In no event will an extension of time be granted for delays that merely extend the duration of non-critical activities, or which only consume float without delaying the project completion date.

12.6.2 **Excusable Delay.** Contractor may be entitled to an equitable adjustment of time, issued via change order, for delays caused by the following:

12.6.2.1 Errors, omissions and imperfections in design which TxDOT corrects by means of changes in the drawings and specifications. Clarifications to the drawings and specifications by TxDOT are not considered changes to the drawings and specifications.

12.6.2.2 Unanticipated physical conditions at the Site which with reasonable diligence could not have been discovered by the Contractor prior to the execution of this Contract and the PM corrects by means of changes to the drawings and specifications or for which the PM directs changes in the Work identified in the Contract Documents.

12.6.2.3 Changes in the Work that effect activities identified in the Contractor's schedule as "critical" to completion of the entire Work, if such changes are ordered by the PM.

12.6.2.4 Suspension of Work for convenience of TxDOT, which prevents Contractor from completing the Work within the Contract Time.

12.6.3 **Excusable Delay Relief.** In the event of such delays the time relief is the time impact to the critical path as determined by analysis of the Contractor's schedule. If the Contractor and TxDOT cannot agree on the time extension, TxDOT may issue a ULCO for fair and reasonable time extension. In the event that the Contractor incurs additional direct costs because of the delay, they are to be determined pursuant to the provisions of *Article 14*.

12.6.4 **Non-compensable Delay.** Contractor may be entitled to an equitable adjustment of time, issued via change order, for delays caused by the following:

12.6.4.1 "Weather Day" is a day on which the Contractor's current schedule indicates Work is to be done, and on which inclement weather and related site conditions prevent the Contractor from performing seven (7) continuous hours

of Work between the hours of 7:00 a.m. and 6:00 p.m. Weather days are non-compensable delays. When weather conditions at the site prevent work from proceeding, immediately notify the PM or designated representative for confirmation of the conditions. At the end of each calendar month, submit to the PM or designated representative a list of Weather Days occurring in that month along with documentation of the impact on critical activities. Such documentation shall include the impact of any concurrent delay occurring during the "Weather Days" in question.

12.6.4.2 Force Majeure shall mean any delays, hindrances, or suspensions of the Work for (1) unexpected natural events (sometimes called "acts of God"); (2) strikes, labor disputes, labor shortages, or material shortages outside of the Contractor's reasonable control; (3) acts of public enemy; (4) riots; (5) epidemics disabling the labor force; (6) landslides; (7) earthquakes affecting the Project; (8) fires; (9) hurricanes (10) tornadoes; (11) partial or entire failure of public utilities affecting the Project; (12) delays associated with concealed, unknown, or unforeseen conditions associated with the Property which with reasonable diligence could not have been discovered by the Contractor prior to execution of this Contract; (13) delay in issuing any governmental or regulatory permit, license or approval necessary or required for implementation of the Project which with reasonable diligence could not have been avoided by the Contractor; (14) any other similar cause or event not reasonably within the Contractor's / subcontractor's control and not resulting from their errors, omissions or negligent acts.

12.6.5 **Non-compensable Delay Relief.** Contractor's sole relief in the event of such Weather Day or Force Majeure or both delays, hindrances, or suspensions of the Work is the time impact to the critical path as determined by analysis of the Contractor's schedule. Upon review and concurrence of the time impact documentation by the PM or designated representative a non-compensable time extension to the Contract Time will be issued by Change Order. In the event the Contractor and TxDOT cannot agree on the time extension, TxDOT may issue a ULCO for fair and reasonable time extension. When such delays, hindrances, or suspensions are the result of the conditions defined under *Article 14*, the Contractor's relief will be governed by the conditions of said Article should the Contract be terminated under *Article 17*.

12.6.6 **Concurrent Delay.** When the completion of the Work is simultaneously delayed by an excusable delay and a delay arising from a cause not designated as excusable, the Contractor may not be entitled to a time extension for the period of concurrent delay.

12.6.7 **Other Time Extension Requests.** If the Contractor believes that the completion of the Work is delayed by a circumstance other than for changes directed to the Work, weather, or force majeure, they shall give the PM or designated representative written notice, stating the nature of the delay, activities potentially affected, and evidence documenting the cause of delay within five (5) calendar days after the onset of the event or circumstance giving rise to the excusable delay. Clarifications to the drawings and specifications by TxDOT are not considered changes to the drawings and specifications.

12.6.7.1 Contractor shall provide with each Time Extension Request a quantitative demonstration of the impact of the delay on project completion time, based on the Work Progress Schedule and include with Time Extension Requests a reasonably detailed narrative setting forth:

12.6.7.1.1 The nature of the delay and its cause; the basis of the Contractor's claim of entitlement to a time extension.

12.6.7.1.2 Documentation of the actual impacts of the claimed delay on the critical path indicated in the Contractor's Work Progress Schedule, and any concurrent delays.

12.6.7.1.3 Description and documentation of steps taken by the Contractor to mitigate the effect of the claimed delay, including, when appropriate, the modification of the Work Progress Schedule.

12.6.7.2 TxDOT will respond, subject to receipt of all required information, to the Time Extension Request by providing to the Contractor written notice of the number of days granted, if any, and giving its reason if this number differs from the number of days requested by the Contractor.

12.6.7.2.1 TxDOT will not grant time extensions for delays that do not affect the Contract Completion Date.

12.6.7.2.2 TxDOT will respond to each properly submitted Time Extension Request within fifteen (15) calendar days following receipt of all required information. If TxDOT cannot reasonably make a determination about the Contractor's entitlement to a time extension within that time, TxDOT will notify the Contractor in writing. Unless otherwise agreed by the Contractor, TxDOT has no more than fifteen (15) additional calendar days to prepare a final response. If TxDOT fails to respond within forty-five (45) calendar days from the date the Time Extension Request is received, the Contractor is entitled to a time extension in the amount requested.

12.7 **NO DAMAGES FOR DELAY.** Contractor has no claim for monetary damages for delay or hindrances to the work from any cause, including without limitation any act or omission of TxDOT.

12.8 **DUTY TO PERFORM.** No extension of time releases the Contractor or the Surety furnishing a performance or payment bond, if any, from any obligations under the contract or such a bond. Those obligations remain in full force until the discharge of the Contract.

12.9 **FAILURE TO COMPLETE WORK WITHIN THE CONTRACT TIME. TIME IS OF THE ESSENCE FOR THIS CONTRACT.** Contractor's failure to substantially complete the Work within the Contract Time will cause damage to TxDOT. These damages are liquidated by agreement of the Contractor and TxDOT, as set forth in the Contract Documents.

12.10 **LIQUIDATED DAMAGES.** TxDOT may collect Liquidated Damages due from the Contractor directly or indirectly by reducing the contract sum in the amount of Liquidated Damages stated in the Contract Documents.

12.10.1 The amount per day given in the following schedule will be deducted from the money due or to become due to the Contractor, not as a penalty, but as liquidated damages and added expense for engineering and administrative supervision.

PER DAY RATE FOR AMOUNT OF ORIGINAL CONTRACT		
Greater Than	Through	Amount Per Calendar Day
$ 0	$ 100,000	$ 570
$ 100,000	$ 500,000	$ 590
$ 500,000	$ 1,000,000	$ 610
$ 1,000,000	$ 1,500,000	$ 685
$ 1,500,000	$ 3,000,000	$ 785
$ 3,000,000	$ 5,000,000	$ 970
$ 5,000,000	$ 10,000,000	$ 1,125
$ 10,000,000	$ 20,000,000	$ 1,285
$ 20,000,000		$ 2,590

Article 13 Payments

13.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

13.2 **SCHEDULE OF VALUES.** Contractor shall submit to the PM or designated representative a Schedule of Values accurately itemizing each line item by material and labor for the various classifications of the Work based on the organization of the specification sections and using the same activity names and terms as the Work Progress Schedule. The Schedule of Values shall include line items for general conditions, fees, TxDOT allowance items and any additional detail as required by the PM or designated representative. The format for the Schedule of Values will be as provided by TxDOT.

13.2.1 The accepted Schedule of Values will be the basis for the progress payment under the Contract. No progress payments will be made prior to receipt of a Schedule of Values in such detail as acceptable to the PM or designated representative.

13.2.2 No progress payments will be made prior to receipt and acceptance of the Schedule of Values, provided in such detail as required by the PM, and submitted not less than twenty-one calendar (21) days prior to the first request for payment. The Schedule of Values shall follow the order of trade divisions of the specifications and include costs for general conditions, fees, contingencies, and TxDOT allowance items, if applicable, so that the sum of the items will equal the contract price. Each line item will contain labor and material value categories with values assigned as appropriate, the subtotal thereof equaling the value of the work in place when complete.

13.3 **LUMP SUM PAYMENT.** Contractor may elect to receive a single lump sum payment, adjusted as may be required by the requirements of the Contract Documents, for the Work after final acceptance of the Work by TxDOT. Work progress payments will not be made without the Contractor submitting a Schedule of Values acceptable to TxDOT.

13.4 **TEXAS IDENTIFICATION NUMBER.** Contractor will be required to secure from the Texas Comptroller of Public Accounts, a Texas Payee Identification Number. The Texas Payee Identification Number must correspond to the person(s) or entity shown on the Contract. A valid Texas Payee Identification Number is required prior to payment being processed for this Contract.

13.5 **PROGRESS PAYMENTS.** Contractor will receive periodic progress payments for Work performed, materials in place, suitably stored on site, or as otherwise agreed to by TxDOT and the Contractor. Payment is not due until receipt by the PM or designated representative of a correct and complete Pay Application in electronic copy format. Progress payments are made provisionally and do not constitute acceptance of work not in accordance with the Contract Documents. TxDOT will not process progress payment applications for Change Order work until all required parties execute the Change Order.

13.5.1 **Preliminary Pay Worksheet.** Once each month that a progress payment is to be requested, Contractor shall submit to the PM or designated representative a complete, clean copy of a preliminary pay application such that it is received by the PM or designated representative a minimum of seven (7) calendar days prior to any scheduled monthly work progress meeting, and shall include the following:

13.5.1.1 Contractor's estimate of the amount of Work performed, labor furnished and materials incorporated into the Work during the time covered by the application for payment, using the accepted Schedule of Values and approved form.

13.5.1.2 Copies of original invoices for any materials or equipment stored on site but not incorporated into the Work for which the Contractor is requesting payment.

13.5.1.3 Insurance certificates, invoices and any other documents required by the Contract Documents for materials or equipment stored off-site for which the Contractor is requesting payment.

13.5.1.4 TxDOT's Contractor's Application for Payment form reflecting any adjustments to the Contract Sum or Contract Time approved during the period of time covered by the application for payment.

13.5.1.5 An updated Work Progress Schedule including the Executive Summary and all required schedule reports.

13.5.1.6 An updated submittal schedule/register, if required.

13.5.1.7 An updated HUB Subcontracting Plan (HSP) Prime Contractor Progress Assessment Report and associated documentation for any modification to the plan authorized during the time covered by the application for payment.

13.5.1.8 Copy of any apprenticeship or trainee program registered with the United States Department of Labor, Employment and Training Administration if such program is being utilized by Contractor or any Subcontractor in performance of the Work. The Contractor shall provide a copy of any program modifications, updates or additional programs with subsequent applications for payment.

13.5.1.9 Such additional documentation as TxDOT may require as set forth in a Special Condition or elsewhere in the Contract Documents.

13.5.2 **Contractor's Application for Progress Payment.** Subject to the Contractor providing a complete preliminary pay application: Within the time frame as set forth in *Article 13* the Contractor, PM and A/E will conduct a conference call review of the preliminary pay application prior to the scheduled monthly work progress meeting. Based on this review, the PM and A/E may require modifications to the preliminary pay application prior to submittal of the formal application for progress payment. The Contractor shall submit for approval during the scheduled monthly progress meeting the formal application for progress payment on the appropriate and completed forms reflecting the required modifications. Approval is subject to the condition TxDOT may require modification to the application based on observations of the Work made during the site visit. The Contractor shall promptly make such revisions as necessary for approval. Attach all additional documentation required by the PM and A/E, as well as an affidavit affirming that all payrolls, bills for labor, materials, equipment, subcontracted work and other indebtedness connected with the Contractor's invoice are paid or will be paid within the time specified in Texas Government Code, Chapter 2251. No invoice is complete unless it fully reflects all required modifications and attaches all required documentation including, but not limited to, the following:

13.5.2.1 TxDOT Contractor's Application for Payment form must be signed by a corporate officer or a representative duly authorized by the Contractor,

13.5.2.2 Updated Schedule of Values form;

13.5.2.3 Updated Work Progress Schedule;

13.5.2.4 TxDOT Contractor's Affidavit of Payments of Debts and Claims (monthly);

13.5.2.5 HUB Subcontracting Plan (HSP) Prime Contractor Progress Assessment Report;

13.5.2.6 Copies of manufacturer/supplier original invoice price for materials and equipment stored on the site but not incorporated in the Work payment is being requested for; and

13.5.2.7 Copies of warehouse records, receipts and manufacturer/supplier invoices for any materials and equipment stored off site verifying current status of quantities and their disposition.

13.6 **OWNER'S DUTY TO PAY.** Owner has no duty to pay the Contractor except on receipt by the PM or designated representative of the following:

13.6.1 a complete TxDOT Contractor's Application for Payment form certified by the Contractor, PM and designated representatives, as required, and all attachments;

13.6.2 the Contractor's updated Work Progress Schedule; and

13.6.3 confirmation that the Contractor's as-built documentation at the site is kept current.

13.6.4 **Stored Material.** Payment for stored materials and equipment confirmed by the PM or designated representative to be on-site or otherwise properly stored but not incorporated into the Work is limited to the manufacturer/supplier original invoice price or the scheduled value for the materials or equipment, whichever is less. Payment for off-site stored materials or equipment is subject to compliance with the provisions of *Article 13.8*.

13.6.5 **Retainage.** TxDOT will withhold from each progress payment, as retainage, five (5) percent of the total earned amount, the amount authorized by law, or as otherwise set forth in a Special Condition. Retainage may be managed in conformance with Transportation Code §223.010.

13.6.5.1 Provide written consent of Surety for any request for release of retainage.

13.6.6 **Price Reduction to Cover Loss.** TxDOT may reduce any application for payment, prior to payment to the extent necessary to protect TxDOT from loss on account of actions of the Contractor including, but not limited to:

13.6.6.1 Defective or incomplete Work not remedied.

13.6.6.2 Damage to Work of a separate Contractor.

13.6.6.3 Failure to maintain scheduled progress or reasonable evidence that the Work will not be completed within the Contract Time.

13.6.6.4 Persistent failure to carry out the Work in accordance with the Contract Documents.

13.6.6.5 Reasonable evidence that the Work cannot be completed for the unpaid portion of the contract sum.

13.6.6.6 Assessment of fines for violations of Prevailing Wage Rate law.

13.6.6.7 Failure to include the appropriate amount of retainage for that periodic progress payment.

13.6.6.8 Failure to maintain acceptable storage/protection for stored materials and equipment on-site and off-site.

13.6.7 **Final Payment.** For purposes of Tex. Gov't Code § 2251.021 (a) (2), the date the performance of service is complete is the date when the PM or designated representative approves the final application for payment.

13.6.8 **Title to Material and Work**. Title to all material and Work covered by progress payments transfers to TxDOT upon payment.

13.6.8.1 Transfer of title to TxDOT does not relieve the Contractor of the sole responsibility for the care and protection of materials and Work upon which payments have been made until final acceptance of the entire Work, or the restoration of any damaged Work, or waive the right of TxDOT to require the fulfillment of all the terms of the Contract.

13.7 **CONTINUED OBLIGATIONS.** Progress payments to the Contractor do not release the Contractor or its Surety from any obligations under this Contract.

13.7.1 Upon TxDOT's request, furnish manifest proof of the status of Subcontractor's accounts in a form acceptable to TxDOT.

13.7.2 Pay estimate certificates must be signed by a corporate officer or a representative duly authorized by the Contractor.

13.7.3 Provide copies of bills of lading, invoices, delivery receipts or other evidence of the location and value of such materials in requesting payment for materials not incorporated in the work.

13.7.4 For purposes of Texas Government Code § 2251.021(a)(2), the date the performance of service is complete is the date when the PM approves the final application for payment. The effects of Final Payment are as set forth in *Article 15.4.7*.

13.8 **OFF-SITE STORAGE.** With prior approval by TxDOT and in the event Contractor elects to store materials or equipment at an off-site location, the Contractor shall abide by the following conditions, unless otherwise agreed to in writing by TxDOT and the Contractor.

13.8.1 Store materials and equipment in a Bonded Commercial Warehouse.

13.8.2 Provide separate Insurance Coverage adequate not only to cover materials and equipment while in storage, but also in transit from the off-site storage areas to the project site. Copies of duly authenticated Certificates of Insurance, made out to insure TxDOT, must be filed with PM or designated representative.

13.8.3 Inspection by PM or designated representative is allowed at any time. TxDOT must be satisfied with the security, control, maintenance, and preservation measures.

13.8.4 Materials and equipment for this project must be physically separated and marked for the project in a sectioned-off area. Only materials and equipment which have been approved through the submittal process are to be considered for payment.

13.8.5 TxDOT reserves the right to reject materials and equipment at any time prior to final acceptance of the complete Contract if they do not meet Contract requirements, regardless of any previous progress payment made.

13.8.6 With each monthly payment estimate, submit a report to the PM and A/E listing the quantities of materials and equipment already paid for and still stored in the off-site location.

13.8.7 Make warehouse records, receipts and invoices available to PM or designated representatives, upon request, to verify the quantities and their disposition.

13.8.8 In the event of Contract termination or default by Contractor, the items in storage off-site, upon which payment has been made, will be promptly turned over to TxDOT or TxDOT's agents at a location near the jobsite as directed by the PM or designated representative. The full provisions of PERFORMANCE AND PAYMENT BONDS, if required, on this project cover the materials off-site in every respect as though they were stored on the Project Site.

Article 14 Contract Changes

14.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

14.2 **MINOR CHANGES.** TxDOT has the authority to order minor changes in the Work that do not involve an adjustment in the Contract Sum or an extension of the Contract Time. Such changes shall be effected by written order, i.e. Supplemental Instruction, which the Contractor shall carry out promptly and record on as-built record documents.

14.3 **EMERGENCY CHANGE.** Emergency changes to save life or property may be initiated by the Contractor alone (per *Article 9*) with the claimed cost and/or time of such work fully documented as to necessity and detail to TxDOT's satisfaction.

14.4 **UNILATERIAL CHANGE ORDER.** TxDOT, without invalidating the Contract, may order changes in the Work not included in the Contract that are necessary for the completion of the project, and will pay the Contractor a reasonable sum.

14.5 **CHANGE ORDERS.** A Change Order issued after execution of the Contract is a written order to the Contractor, signed by TxDOT (in accordance with TxDOT signature authorization policy), the Contractor, and (when applicable) the Architect/Engineer, authorizing a change in the Work or an adjustment in the Contract Sum or the Contract Time. The Contract Sum and the Contract Time can only be changed by Change Order. A Change Order signed by the Contractor indicates his agreement therewith, including the adjustment in the Contract Sum and/or the Contract Time. Subject to compliance with TxDOT signature authorization policy, the PM may issue written authorization for the Contractor to proceed with work of a change order in advance of final execution by all parties.

14.5.1 TxDOT, without invalidating the Contract, may order changes in the Work within the general scope of the Contract consisting of additions, deletions or other revisions, and the Contract Sum and the Contract Time will be adjusted accordingly, if required. All such changes in the Work shall be authorized by Change Order, and shall be performed under the applicable conditions of the Contract Documents. Authorization to execute a Change Order is reserved exclusively to TxDOT and may not be delegated to a private firm under contract with the State.

14.5.2 If such changes cause an increase or decrease in the Contractor's cost of, or time required for, performance of the Contract, a mutually agreeable, equitable, adjustment shall be made and confirmed in writing in a Change Order.

14.5.3 It is recognized by the parties hereto and agreed by them that the specifications and drawings may not be complete or free from errors, omissions and imperfections or that they may require changes or additions in order for the work to be completed to the satisfaction of TxDOT. Accordingly, it is the express intention of the parties, notwithstanding any other provisions in this Contract, that any errors, omissions or imperfections in such specifications and drawings, or any changes in or additions to the specifications and drawings or to the Work ordered by TxDOT, and any resulting delays in the work or increases in Contractor's costs and expenses, shall not constitute or give rise to any claim, demand or cause of action of any nature whatsoever in favor of Contractor, whether for breach of contract, *quantum meruit*, or otherwise. TxDOT shall be liable to Contractor for the sum stated to be due Contractor in any Change Order, approved and signed by both parties. It is agreed hereby that such sum, together with any extension of time contained in said Change Order, shall constitute full compensation to Contractor for all costs, expenses and damages to Contractor, whether direct, consequential or otherwise that are incident to, arising out of, or resulting directly or indirectly from the work performed by Contractor under such Change Order.

14.5.4 Procedures for administration of Change Orders shall be established by TxDOT and stated in the Contract Documents.

14.5.5 No order, oral statement, or direction from TxDOT or any duly appointed representative shall be treated as a Change Order or entitle the Contractor to an adjustment.

14.5.6 The Contractor agrees that TxDOT and any of its duly authorized representatives shall have access and the right to examine, during normal business hours, any books, documents, papers, and records of the Contractor related to the Project. Further, the Contractor agrees to include this provision in all its subcontracts. The period of access and examination described herein also relates to appeals under *Article 18* of the Contract, litigation, or the settlement of claims arising out of the performance of this Contract. The period of access and examination shall continue until final disposition of such claims, appeals or litigation.

14.6 **ADMINISTRATION OF CHANGE ORDER REQUESTS.** All changes in the Contract shall be administered in accordance with TxDOT procedures.

14.6.1 **Routine Change.** Routine changes in the Contract shall be formally initiated by TxDOT with a Request for Proposal form detailing requirements of the proposed change for pricing by the Contractor. This action may be preceded by communications between the Contractor, PM and/or designated representative concerning the need and nature of the change, but such communications shall not constitute a basis for beginning the proposed Work by the Contractor without a Change Order. Approval of the Contractor's cost proposal by TxDOT, in compliance with TxDOT's signature authorization policy, will be required for authorization to proceed with the work being changed. TxDOT will not be responsible for the cost of work changed without prior approval and the Contractor may be required to remove such work at no cost to TxDOT.

14.6.1.1 Contractor shall furnish TxDOT an itemized breakdown, in such detail and form as acceptable to TxDOT, of all costs and supporting information including but not limited to quantities, material / equipment prices, tier subcontracted work performed, labor rates and employer payments, compensable insurance and rental rates for all proposed Change Order work. The itemized breakdown detail shall be the same for any Subcontractor work. Photocopies of Subcontractor and vendor/supplier proposals shall be furnished unless specifically waived in writing by the PM or designated representative. The Contractor shall provide a written response to TxDOT's Request for Proposal within fifteen (15) calendar days of receipt unless the Contractor and TxDOT mutually agree otherwise.

14.6.2 **Unexpected Circumstance.** Any unexpected circumstance which necessitates an immediate change in order to avoid a delay in progress of the Work may be expedited by verbal communication and authorization by TxDOT in compliance with TxDOT's signature authorization policy, with written confirmation following within twenty-four (24) hours. A limited scope not-to-exceed estimate of cost and time will be requested prior to authorizing work to proceed. TxDOT reserves the right to issue a ULCO or Supplemental Instruction when in its sole opinion the circumstance which necessitated the change request could have been reasonably detected by the Contractor in fulfilling its duty to review the Contract Documents.

14.6.3 **Emergency Change.** Emergency changes to save life or property may be initiated by the Contractor alone (see *Article 9.4*) with the claimed cost and/or time of such work to be fully documented as to necessity and detail of the reported costs and/or time to TxDOT's satisfaction.

14.6.4 **Valuation of Change Order Work**. The value of changes in the Work, either additive or deductive, executed under a Change Order, shall be determined in one of the following ways:

14.6.4.1 **Lump Sum**. By acceptance of a lump sum proposal as described by the following paragraphs.

14.6.4.1.1 Contractor shall furnish TxDOT an itemized breakdown, in such detail and form as acceptable to TxDOT, of all costs and supporting information including but not limited to quantities, material prices including supplier invoices/quotes, tier subcontracted work performed, labor rates and employer payments, and rental rates. The itemized breakdown detail shall be the same for any Subcontractor work. The Contractor shall furnish TxDOT the following additional information in the itemized breakdown, including insurance charges and bond charges used in computing the lump sum proposal. The information shall also be provided by any Subcontractor work.

14.6.4.1.2 Cost shall include:

- Labor cost, including the classifications through foremen when engaged in the actual and direct performance of the work, and actual employer payments to or on behalf of workers for health and welfare, pension, vacation, insurance, and any similar charges imposed by law (Social Security Tax, Workers' Compensation) or required by applicable collective bargaining agreements;
- materials, installed permanently in the work or expended in performance thereof;
- rental cost of construction plant and equipment at the work site;
- energy, fuel, and supplies consumed in operation of power-driven equipment;
- additional insurance cost, if any and only cost applicable to insurance limits required by the Contract Documents, directly resulting from the additional Work;
- necessary professional design and consulting fees; revisions of previously finalized shop drawings and/or fabrication drawings, and
- other allowable costs involved with Change Order work, except those costs listed in *Paragraph 14.6.4.1.3*.
- In lieu of providing information for all employer payments to or on behalf of workers, excluding actual gross wages, the Contractor proposal may use a percentage factor based on methodology acceptable to TxDOT, which shall constitute full compensation for all employer payments other than actual gross wages. The Contractor shall provide complete supporting information for calculation of the percentage factor(s) when so requested by TxDOT.

14.6.4.1.3 Costs shall not include: (These costs shall be considered a part of overhead and profit or markups and no separate allowance will be made therefore)

- Labor for superintendents, assistant superintendents, office personnel (home and field);

- timekeepers and maintenance mechanics at any level of contracting;
- per diem and travel allowances for any of the aforementioned labor classifications;
- pieces of equipment, hand and small tools, or instruments having a new value of $500.00 or less, whether or not consumed by use;
- safety programs;
- scheduling;
- on site and main offices and operating costs;
- incidental job burdens;
- modifications to record drawings;
- guarantee period cost allowances;
- punch list allowances, and
- insurance other than mentioned in *Paragraph 14.6.4.1.2*.

14.6.4.1.4 For work performed by the Contractor's forces, the maximum allowable percentages for overhead and profit on changes will not exceed:

- fifteen percent (15%) if the total of self-performed work is less than $10,000;
- ten percent (10%) if the total of self-performed work is between $10,000 and $20,000; and
- seven and one half percent (7.5%) if the total of self-performed work is over $20,000 for any specific change priced.

14.6.4.1.5 For subcontracted Work each affected Subcontractor shall figure its cost, overhead and profit as described above.

14.6.4.1.6 All subcontractor costs shall be combined, and to that total subcontractor cost the Contractor will be allowed to add a maximum mark-up of:

- ten percent (10%) if the total of all subcontracted work is less than $10,000;
- seven and one half percent (7.5%) if the total of all subcontracted work is between $10,000 and $20,000; and
- five percent (5%) if the total of all subcontracted work is over $20,000.

14.6.4.1.7 To the total of the above costs, Contractor will be allowed to add Bond cost, if bonds are required, if the change results in an increase in the Bond premium paid by the Contractor. Contractor shall provide written evidence from the Bonding Company of any increase in the Bond premium to TxDOT. Subcontractors shall be allowed to add Bond cost to their total costs if the changed work results in an increase in the Bond premium paid by the Subcontractor, and Contractor's contract with the Subcontractor requires the Subcontractor to maintain a bond for their Work. Contractor shall provide a copy of written evidence from the Bonding Company for any additional Subcontractor bond cost that is requested for inclusion in the change order.

14.6.4.1.8 On lump sum changes involving both additions and deletions, percentages for overhead and profit will be allowed only on the net addition.

14.6.4.2 **Unit Price Work.** By acceptance of unit prices agreed upon by TxDOT and the Contractor.

14.6.4.2.1 Unit price is full compensation for all materials, equipment, labor, tools, and supplies necessary to complete the item of work. Unit price includes all markups, overhead, profit, insurance, bond, etc. costs.

14.6.4.3 If a Surety has assumed the responsibilities of the Contract, TxDOT may pay the Surety for the completion contractor's profit and overhead, but it will not pay the Surety any profit or overhead.

14.6.4.4 TxDOT does not accept and will not pay for additional contract cost identified as indirect, consequential, or as damages caused by delay due to Force Majeure or the Contractor.

14.6.5 **Contractor Cost Reduction Proposal.** Contractor may submit a cost reduction proposal for changing the requirements of the Contract Documents. The proposal shall demonstrate that changing the Contract requirements would:

14.6.5.1 Represent an advantage to TxDOT over the specified requirement;

14.6.5.2 Result in a net reduction in the total Contract Sum;

14.6.5.3 Not impact any essential function or characteristic of the Work such as safety, service life, reliability, economy of operation, esthetic, ease of maintenance, and necessary standardize features; and

14.6.5.4 Not detrimentally affect the Contract completion date.

14.6.5.5 All costs for compliance with these requirements, whether accepted or not, shall be borne by the Contractor.

14.6.5.6 The determination of TxDOT as to acceptability of the proposal will be final and TxDOT may accept in whole or in part any proposal submitted pursuant to this provision by issuing a Change Order that will identify the proposal on which it is based. The Change order will provide for an equitable adjustment in the Contract Sum in accordance with the provisions herein and will revise any other affected provisions of the Contract Documents.

14.7 CLAIMS FOR ADDITIONAL COSTS

14.7.1 In order for the Contractor to make a valid claim for an increase in the Contract Sum for unforeseen circumstances, Contractor shall give the PM or designated representative written notice thereof within ten (10) days after the occurrence of the event giving rise to such claim. Contractor shall not execute any work involving additional cost or time, except in an emergency endangering life or property without an approved Change Order or written authorization issued in accordance with TxDOT's signature authorization policy. Any TxDOT approved change in the Contract Sum shall be authorized by Change Order. If TxDOT and the Contractor cannot agree on the amount of the adjustment in the Contract Sum, it shall be determined as set forth under ***Article 18***.

14.7.2 If the Contractor claims that additional cost is involved because of, but not limited to, 1) any written interpretation of the Contract Documents, 2) any order by TxDOT to stop the Work where the Contractor was not at fault, 3) any written order for a minor change in the Work, the Contractor shall make such claim as stated above.

14.7.3 Failure of the Contractor or his Subcontractors failure to notify the A/E of obvious discrepancies or omissions in the Bid/Proposal Documents during the pre-bid/pre-proposal period, but claim additional costs for corrective work after contract award, shall be deemed an intent to circumvent competitive bidding for necessary corrective work. In such case, TxDOT, in its sole discretion, may let a separate contract for the corrective work, or issue a Unilateral Change Order to require performance by the Contractor. Claims for time extensions or for extra cost resulting from delayed notice of contract document discrepancies or omissions will not be considered by TxDOT.

14.8 **CONCEALED SITE CONDITIONS.** If, in the performance of the Contract, subsurface, latent or concealed conditions at the site are found to be materially different from the information included in the bid/proposal documents, or if unknown conditions of an unusual nature are disclosed differing materially from the conditions usually inherent in work of the character shown and specified, the PM and A/E shall be notified in writing of such conditions before they are disturbed. Upon such notice, or upon its own observation of such conditions, the A/E, upon the approval of the PM, will promptly make such changes in the Drawings and Specifications as they deem necessary to conform to the different conditions. Any increase or decrease in the cost of the Work, or in the time within which the Work is to be completed resulting from such changes will be adjusted by Change Order, subject to TxDOT's approval.

14.9 **EXTENSION OF TIME.** All Changes to the Contract Time shall be made by Change Order.

14.9 **CONTRACTOR'S RISK OF PERFORMANCE**. Except as expressly provided in this Article, other contract provisions or as may be determined by ***Article 18***, the Contractor shall not be entitled to an increase in the Contract Sum or Contract Time and shall bear full responsibility for all risks affecting the Contractor's cost of performance.

Article 15 Project Completion and Acceptance

15.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

15.2 **CLOSING INSPECTIONS**

15.2.1 **Request for Substantial Completion Inspection.** When the Contractor considers the entire Work or part thereof Substantially Complete, it shall notify the PM or designated representative in writing that the Work will be ready for Substantial Completion Inspection on a specific date. Contractor shall include with this written notice:

15.2.1.1 Contractor's Punch List to indicate that it has previously inspected all Work associated with the request for inspection;

15.2.1.2 Documentation it has completed or scheduled items required for Substantial Completion to be complete before the specific date requested for the Substantial Completion Inspection.

15.2.1.3 If any item on the Punch List is required for Substantial Completion and not complete or scheduled for completion the Contractor shall not request a Substantial Completion Inspection.

15.2.1.4 If any item on the Punch List will prevent use of the building for the purposes it is intended to be utilized and not corrected, the Contractor shall not request a Substantial Completion Inspection.

15.2.1.5 The failure to include any items on the Punch List does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

15.2.1.6 TxDOT will review the list of items and schedule the requested inspection, or inform the Contractor in writing that such an inspection is premature because the Work is not sufficiently advanced, items required to be complete or scheduled for completion are not completed, or conditions are not as represented on the Contractor's list.

15.2.2 **Substantial Completion Inspection**. On the date requested by Contractor, or as mutually agreed upon, with consideration of the status of open Punch List items, the PM or designated representative, Contractor and other TxDOT representatives as determined by TxDOT, will jointly attend the Substantial Completion Inspection, which shall be conducted by the PM or designated representative. If the PM or designated representative determines that the Work is Substantially Complete, the PM will issue a Certificate of Substantial Completion to be signed by the A/E of Record, if required, TxDOT and Contractor, establishing the date of Substantial Completion. If TxDOT determines the Work is not Substantially Complete the Contractor will be so notified. The PM or designated representative will provide with or independent of this certificate a list of Substantial Completion Punch List items. The term "Substantial Completion Punch List" items shall mean details of construction and mechanical and electrical adjustments which are minor in character and do not materially interfere with TxDOT's safe use, enjoyment and operation of the Project or designated portions thereof. If TxDOT elects to occupy the facility upon determination of Substantial Completion, the Contractor shall complete all corrective Work at the convenience of TxDOT, without disruption to TxDOT's use of the facility for its intended purposes.

15.2.3 **Requirements for Substantial Completion.** The Certificate of Substantial Completion for all or a designated portion of the Work will not be issued if the following items are incomplete, unless otherwise agreed to by TxDOT in writing, as they are considered essential elements of the Project and completion of these is a prerequisite for TxDOT's safe use, enjoyment and operation of the project or designated portions thereof.

15.2.3.1 Complete and accepted operation and maintenance (O&M) manuals for all installed equipment, systems and like items to include, but not be limited to, submittals, shop drawings, operation and maintenance instructions, wiring diagrams, spare parts lists, test/inspection results/reports and written warranties,

15.2.3.2 Verification that training of designated TxDOT personnel for various items of the Work requiring training as set forth in the Contract Documents is complete, as evidenced by submittal of a copy of the "sign in" sheet for each required training session;

15.2.3.3 A notarized affidavit attesting to TxDOT no hazardous materials were incorporated into the Work unless prior written approval of TxDOT was granted, as verified by attaching a copy of the TxDOT authorization,

15.2.3.4 A notarized certification to TxDOT that all equipment and materials used in fulfillment of their contract responsibilities are non-Asbestos Containing Building Materials (ACBM) in compliance with the Texas Asbestos Health Protection Rules as administered by the Texas Department of State Health Services;

15.2.3.5 Verification, to the satisfaction of the PM or designated representative, that inspections required by any authority having jurisdiction over any element of the Work have been conducted which shall include any registrations as may be required and the issuance of any permits, licenses, certificates, etc. as may be required for any system or equipment, i.e. boilers, elevators, etc., unless specifically stated otherwise in the Plans and Specifications. The Texas Accessibility Standards (TAS) compliance review and inspection will be the responsibility of TxDOT or authorized representative and is not a condition for Substantial Completion;

15.2.3.6 Demonstration, to the satisfaction of the PM or designated representative(s), that all equipment and systems function as required by the Contract Documents, i.e commissioning;

15.2.3.7 Completion of landscaping as set forth in the Contract Documents; and

15.2.3.8 Submittal of all asbestos containing material abatement documentation and/or mold remediation documentation, if asbestos abatement and/or mold remediation is part of the Contract Work.

15.2.4 **Substantial Completion Punch List.** In the event the thirty (30) calendar day time frame or the time frame set forth in the Certificate of Substantial Completion to complete the Substantial Completion Punch List Work expires and TxDOT has not been provided written notice from the Contractor that the Work is ready for Final Completion Inspection, and as **TIME IS OF THE ESSENCE IN COMPLETION OF THE WORK**, TxDOT will provide the Contractor written notice of a date specific an inspection will be held. The Contractor, PM or designated representative and other TxDOT representatives as determined by TxDOT shall conduct the inspection. If TxDOT determines the Substantial Completion Punch List Work is not complete and/or corrected, TxDOT shall, without invalidating the Contract, have the right, upon written notice to the Contractor, to complete the Work using duly qualified contractors or TxDOT forces. The Contractor shall reimburse TxDOT for any reasonable costs incurred by TxDOT in completing the Work with offsets and deductions in the Final Payment. This provision does not invalidate any other provision in the Contract Documents available to TxDOT for completion and/or correction of the Work.

15.2.5 **Final Completion Inspection**. Contractor shall complete the list of items identified on the Substantial Completion Punch List within the time frame specified and prior to requesting a Final Completion Inspection. Unless otherwise specified, directed by TxDOT in writing or otherwise agreed in writing by the parties, the Contractor shall complete and/or correct all Substantial Completion Punch List work within thirty (30) calendar days of the Substantial Completion date. Upon completion of the Substantial Completion Punch List work, the Contractor shall give written notice to the PM or designated representative that the Work will be ready for Final Inspection on a specific date. Contractor shall include with this written notice:

15.2.5.1 copy of the updated Substantial Completion Punch List indicating resolution of all items;

15.2.5.2 original marked-up As-Built drawings reflecting all modifications and changes made to the Work. If the Project is being delivered in phases the original marked-up As-Built drawings shall be delivered at completion of the last phase.

15.2.5.3 On the date specified or as soon thereafter as is practicable, the PM or designated representative, Contractor and other TxDOT representatives as determined by TxDOT will inspect the Work. The PM or designated representative will submit a Final Punch List of open items that the inspection team requires corrected or completed before final acceptance of the Work.

15.2.6 **Final Punch List.** In the event the Contractor fails to complete the Final Punch List items within seven (7) days of receipt of the Final Punch List or as otherwise agreed to in writing by the parties and as **TIME IS OF THE ESSENCE IN COMPLETION OF THE WORK**, TxDOT shall, without invalidating the Contract, have the right, upon written notice to the Contractor, to complete the Final Punch List Work using duly qualified contractors or TxDOT forces and the Contractor shall reimburse TxDOT for any reasonable costs incurred by TxDOT in completing the Work with offsets and deductions in the Final Payment. This provision does not invalidate any other provision in the Contract Documents available to TxDOT for completion and/or correction of the Work.

15.2.7 **Final Punch List Inspection**. Contractor shall correct or complete all items on the Final Punch List before requesting Final Payment. Unless otherwise agreed to in writing by the parties, the Contractor shall complete this work within seven (7) days of receipt of the Final Punch List and notify the PM or designated representative in writing stating the disposition of each Final Punch List item. The PM or designated representative, Contractor and other TxDOT representatives as determined by TxDOT shall promptly inspect the completed items. When the Final Punch List is complete, and the Contract is fully satisfied according to the Contract Documents, subject to the limitations of the **Effect on Warranty** provision, the PM or designated representative will issue a certificate establishing the date of Final Completion. Final Completion of all Work is a condition precedent to the Contractor's right to receive Final Payment.

15.2.8 **Annotation.** Any Certificate issued under this Article may be annotated to indicate that it is not applicable to specified portions of the Work, or that it is subject to limitation(s) as determined by TxDOT.

15.2.9 **Purpose of Inspection.** Inspection is for determining the completion of the Work, and does not relieve the Contractor of its overall responsibility for completing the Work in a good and workmanlike manner, in compliance with the Contract. Work accepted with incomplete Punch List items or failure of TxDOT or other parties to identify Work that does not comply with the Contract Documents, or is defective in operation or workmanship does not constitute a waiver of TxDOT's rights under the Contract or relieve the Contractor of its responsibility for performance or warranties.

15.2.10 **Additional Inspections.** The Contract Agreement contemplates three (3) comprehensive inspections: the Substantial Completion Inspection, the Final Completion Inspection, and the Completed Final Punch List Inspection. The cost to TxDOT of additional inspections resulting from the Work not being ready for one or more of these inspections shall be charged to the Contractor. TxDOT may issue a Unilateral Change Order deducting these costs from Final Payment. Upon the Contractor's written request, TxDOT will furnish documentation of any costs so deducted. Work added to the Contract by Change Order after the Substantial Completion Inspection is not corrective work for purposes of determining timely completion, or assessing the cost of additional inspections. However, such work shall be subject to all provisions of this Contract.

15.2.11 **Phased and Whole Completion.** The contract may provide, or project conditions may warrant, as determined by the PM or designated representative, that designated elements or parts of the Work be completed in phases. Where phased completion is required or specifically agreed to by the parties, the provisions of the Contract related to Closing Inspections and Occupancy apply independently to each designated element or part of the Work. For all other purposes, unless otherwise agreed by the parties in writing, Substantial Completion of the Work as a whole is the date on which the last element or part of the Work completed receives a Substantial Completion certificate. Final Completion of the Work as a whole is the date on which the last element or part of the Work completed receives a Final Completion certificate.

15.2.12 **Time Charges.** The date Time Charges for the project as a whole terminates will be the date set forth in the Certificate of Substantial Completion for the project issued by TxDOT. When the Work is to be completed in designated elements or portions (phases), time charges for the project will not stop until the date set forth in the Certificate of Substantial Completion for the last phase of the Work issued by TxDOT.

15.3 **TXDOT'S RIGHT OF OCCUPANCY.** TxDOT may occupy or use all or any portion of the Work following Substantial Completion, or at any earlier stage of completion. Should TxDOT wish to use or occupy the Work, or part thereof, at or prior to Substantial Completion, the PM or designated representative will notify the Contractor in writing. Work performed on the premises by third parties on TxDOT's behalf does not constitute occupation or use of the Work by TxDOT for purposes of this Article. All Work performed by the Contractor after occupancy, whether in part or in whole, shall be at the convenience of TxDOT so as to not disrupt TxDOT's use of, or access to occupied areas of the project.

15.4 ACCEPTANCE AND PAYMENT

15.4.1 **Request for Final Payment.** Following the certified completion of all work, including all punch list items, cleanup, and the delivery and approval of record documents, the Contractor shall submit an Application for Final Payment. The Contractor shall include all sums held as retainage and forward the Application for Final Payment to the PM or designated representative for review and approval. If TxDOT determines that any item remains incomplete, including but not be limited to, maintenance and operation manuals, training, guarantees and warranties, record documents and all other items required by the Contract that have not been submitted to and approved by TxDOT, TxDOT may take no action on the Application for Final Payment and return the Application for Final Payment to the Contractor with a list of missing or incomplete items.

15.4.2 **Allowances.** If the Contract Documents contains allowance items, all savings under any of the designated Allowance Items shall accrue to the benefit of TxDOT and the Contract Sum shall be reduced by one hundred percent (100%) of such savings.

15.4.3 **Final Payment Documentation.** No Application for Final Payment is complete unless it fully reflects all required modifications and includes all required executed documentation including, but not limited to, the following:

15.4.3.1 TxDOT Contractor's Application for Payment form;

15.4.3.2 Updated Schedule of Values form;

15.4.3.3 TxDOT' Contractor's Affidavit of Payments of Debts and Claims (final) form;

15.4.3.4 If requested, documentation establishing payment or satisfaction of all such obligations connected with the work of the Contract, such as receipts, releases and waivers of claims, to the extent and in such form as designated by TxDOT;

15.4.3.5 If required, TxDOT Consent of Surety Company to Final Payment form;

15.4.3.6 If required, a signed TxDOT Change Order making final adjustment to the Contract Sum or Contract Time as may be required for offsets and deductions, allowance items reconciliation, time adjustments, or any other item requiring a change to the Contract;

15.4.3.7 HUB Subcontracting Plan (HSP) Prime Contractor Progress Assessment Report,

15.4.3.8 TxDOT Buy America Affidavit form.

15.4.4 **Offsets and Deductions.** TxDOT may deduct from the Final Payment all sums due from the Contractor. If the Certificate of Final Completion notes any Work remaining, incomplete, or defects not remedied, TxDOT may deduct the cost of remedying such deficiencies from the Final Payment. On such deductions, TxDOT will identify each deduction, the amount, and the explanation of the deduction. Such offsets and deductions shall be incorporated via a final Change Order, including Unilateral Change Order as may be applicable.

15.4.5 **TxDOT Approval**. The A/E and PM will review a submitted complete Application for Final Payment promptly but in no event later than ten (10) days after its receipt. The PM will either 1) return the Application for Final Payment to Contractor with corrections for action and resubmission or 2) accept it subject to any offsets and deductions, noting approval and forward for payment processing.

15.4.6 **Final Payment Due**. Final Payment is due and payable by TxDOT, subject to all allowable offsets and deductions, on receipt of a complete Application for Final Payment. If the Contractor disputes any amount deducted by TxDOT, the

Contractor shall give notice of the dispute on or before the thirtieth (30th) day following receipt of Final Payment and *Article 18* shall apply to unresolved disputes.

15.4.7 **Effect of Final Payment (TxDOT).** Final Payment, when accepted by the Contractor, constitutes a waiver of all claims by TxDOT, relating to the condition of the Work except those arising from any one, combination or all of the following:

15.4.7.1 Faulty or defective Work appearing after Substantial Completion (latent defects);

15.4.7.2 Failure of the Work to comply with the requirements of the Contract Documents;

15.4.7.3 Terms of any warranties required by the Contract, or implied by law;

15.4.7.4 Claims arising from personal injury or property damage to third parties; and

15.4.7.5 Disputes pending under *Article 18* that have not been resolved.

15.4.8 **Effect of Final Payment (Contractor).** Acceptance of Final Payment constitutes a waiver of all claims by the Contractor, except those specifically identified in writing and submitted prior to or at the time of Final Payment and disputes pending under *Article 18* that have not been resolved. Provided, however, that the Contract shall not be deemed fully performed and closed until the expiration of all periods of time provided under the Contract Documents or applicable law for the Contractor to submit a claim or protest a Unilateral Change Order (ULCO).

15.4.9 **Effect on Warranty.** Regardless of approval and issuance of Final Payment, the Contract is not deemed fully performed by the Contractor and closed until the expiration of all warranty periods.

Article 16 Warranty and Guaranty

16.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

16.2 **CONTRACTOR'S GENERAL WARRANTY AND GUARANTY.**

16.2.1 Contractor warrants to TxDOT that all Work is executed in accordance with the Contract, complete in all parts and in accordance with approved practices and customs, and of the best finish and workmanship.

16.2.2 Contractor further warrants that unless otherwise specified, all materials and equipment incorporated in the Work under the Contract are new.

16.2.3 TxDOT may, at its option, agree in writing to waive any failure of the Work to conform to the Contract, and to accept a reduction in the Contract Sum for the cost of repair or diminution in value of the Work by reason of such defect. Absent such a written agreement, the Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute and is not waived by any inspection or observation by TxDOT or others, by making any progress payment or final payment, by the use or occupancy of the Work or any portion thereof by TxDOT, at any time, or by any repair or correction of such defect made by TxDOT.

16.2.4 All warranties must include statements that the warranty is assignable to the end user, subject to Texas laws and that venue for any legal proceedings under the warranty shall be in a court of competent jurisdiction in the county where the warranted item is incorporated into the Project.

16.3 **WARRANTY PERIOD.** Except as may be otherwise specified in the Contract Documents or agreed, the Contractor shall repair all defects in materials, equipment, or workmanship appearing within one year from the date of Substantial Completion of the Work at no cost to TxDOT. If Substantial Completion occurs by phase, then the warranty period for that particular Work begins on the date of completion of the relevant phase, or as otherwise stipulated on the Certificate of Substantial Completion for the particular Work. Regardless of approval and issuance of Final Payment, the Contract is not deemed fully performed by the Contractor and closed until the expiration of all warranty periods.

16.4 **LIMITS ON WARRANTY.** Contractor’s warranty and guaranty hereunder excludes defects or damage caused by:

16.4.1 Modification or improper maintenance or operation by persons other than Contractor, Subcontractors, or any other individual or entity for whom Contractor is not responsible.

16.4.2 Normal wear and tear under normal usage after acceptance of the Work by TxDOT.

16.5 **EVENTS NOT AFFECTING WARRANTY**. Contractor’s obligation to perform and complete the Work in a good and workmanlike manner in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor’s obligation to perform the Work in accordance with the Contract Documents:

16.5.1 Observations by TxDOT and/or designated representatives.

16.5.2 Recommendation or authorization to pay any progress or final payment by PM or designated representative.

16.5.3 Issuance of a certificate of Substantial Completion by TxDOT or any payment TxDOT to Contractor under the Contract Documents.

16.5.4 Use or occupancy of the Work or any part thereof by TxDOT.

16.5.5 Any acceptance by TxDOT or any failure to do so.

16.5.6 Any review of a Shop Drawing or sample submittal;

16.5.7 Any inspection, test or approval by others; or

16.5.8 Final payment by TxDOT.

16.6 **SEPARATE WARRANTIES.** If a particular piece of equipment or component of the Work for which the contract requires a separate warranty is placed in continuous service before Substantial Completion, the Warranty Period for that equipment or component will not begin until Substantial Completion, regardless of any warranty agreements in place between suppliers and/or

Subcontractors and the Contractor. The PM or designated representative will certify the date of service commencement in the Substantial Completion Certificate.

16.6.1 In addition to the Contractor's warranty and duty to repair, the Contractor expressly assumes all warranty obligations required under the Contract for specific building components, systems and equipment.

16.6.2 Contractor may satisfy any such obligation by obtaining and assigning to TxDOT a complying warranty from a manufacturer, supplier, or Subcontractor, provided the warranty provides for assignment to the end user. Where an assigned warranty is tendered to TxDOT but does not fully comply with the requirements of the Contract, the Contractor remains liable to TxDOT on all elements of the required warranty not provided by the tendered warranty.

16.6.3 A complying warranty from a manufacturer, supplier, or Subcontractor assigned to TxDOT by the Contractor shall be subject to and governed by the laws of the State of Texas.

16.7 **CORRECTION OF DEFECTS.** Upon receipt of written notice from TxDOT, or any agent of TxDOT designated as responsible for management of the Warranty Period, of the discovery of a defect, the Contractor shall promptly remedy the defect(s), and provide written notice to TxDOT and its designated agent indicating action taken. In case of emergency where delay would cause serious risk of loss or damage to TxDOT, or if the Contractor fails to remedy within thirty (30) days, or within another period agreed to in writing, TxDOT may correct the defect and be reimbursed the cost of remedying the defect from the Contractor or its Surety.

16.8 **CERTIFICATION OF NO ASBESTOS CONTAINING MATERIALS OR WORK.** Ensure compliance with the Asbestos Hazard Emergency Response Act (AHERA–40 CFR 763-99 (7)) from all subcontractors and materials suppliers, and provide a notarized certification to TxDOT that all equipment and materials used in fulfillment of their contract responsibilities are non-Asbestos Containing Building Materials (ACBM). This certification is a condition for Substantial Completion of the Project in whole or in part.

16.9 **TELECOMMUNICATIONS SYSTEM WARRANTY PERIOD.** Except as may be otherwise specified or agreed, repair all defects in materials, equipment, or workmanship appearing within two (2) years from the date of Substantial Completion of the telecommunications system Work at no cost to TxDOT. If Substantial Completion occurs by phase, then the warranty period for the particular telecommunications system Work begins on the date of completion of the relevant phase, or as otherwise stipulated on the Certificate of Substantial Completion for the particular Work. Regardless of approval and issuance of Final Payment, the Contract is not deemed fully performed by the Contractor and closed until the expiration of all warranty periods.

Article 17 Suspension and Termination

17.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

17.2 **SUSPENSION OF WORK FOR CAUSE.** TxDOT may, at any time without prior notice, suspend all or any part of the Work, if TxDOT determines it is considered necessary to prevent or correct any condition of the Work, which constitutes an immediate safety hazard, or which is expected to impair the integrity, usefulness or longevity of the Work when completed, or for any reason set forth in any other Article of the Uniform General Conditions.

17.2.1 TxDOT will give the Contractor a written notice of suspension for cause, setting forth the reason for the suspension and identifying the work suspended. Upon receipt of such notice, the Contractor shall immediately stop the work so identified. As soon as practicable following the issuance of such a notice, TxDOT will initiate and complete a further investigation of the circumstances giving rise to the suspension, and issue a written determination of the findings.

17.2.2 If it is confirmed that the cause was within the control of the Contractor, the Contractor will not be entitled to an extension of time or any compensation for delay resulting from the suspension. If the cause is determined not to have been within the control of the Contractor, and the suspension has prevented the Contractor from completing the Work within the Contract Time, the Contractor may be entitled to a Change Order increasing the Contract Sum and/or extending the Contract Time caused by any such suspension of Work.

17.2.3 Suspension of work under this provision will be no longer than is reasonably necessary to identify and remedy the conditions giving rise to the suspension. If TxDOT and the Contractor cannot reach agreement on the validity of any work suspension issued by TxDOT or on Contractor's entitlement to an adjustment to the Contract Sum and/or Contract Time such dispute shall be resolved pursuant to the *Article 18*.

17.3 **SUSPENSION OF WORK FOR TXDOT'S CONVENIENCE.** Upon seven (7) calendar days written notice to the Contractor, TxDOT may at any time without breach of the Contract suspend all or any portion of the Work for a period of up to thirty (30) days for its own convenience. TxDOT will give the Contractor a written notice of suspension for convenience, which sets forth the dates and number of suspension days for the Work, or any portion of it. When such a suspension prevents the Contractor from completing the Work within the Contract Time, it is an Excusable Delay. A notice of suspension for convenience may be modified by TxDOT at any time on seven (7) calendar days written notice to the Contractor. If TxDOT suspends the Work for its convenience for more than sixty (60) consecutive calendar days, the Contractor may elect to terminate the contract pursuant to the provisions of the Contract.

17.4 **TERMINATION BY TXDOT FOR CAUSE.**

17.4.1 TxDOT may, without prejudice to any right or remedy, terminate the employment of the Contractor and take possession of the site and of all materials, equipment, tools, construction equipment and machinery thereon owned by the Contractor, under any of, but not limited to, the following circumstances.

17.4.1.1 Persistent or repeated failure or refusal, except during complete or partial suspensions of Work authorized under the Contract, to supply enough properly skilled workmen or proper materials to continue prosecution of the Work,

17.4.1.2 Persistent disregard of laws, ordinances, rules, regulations or orders of any public authority having jurisdiction, including the PM or designated representative,

17.4.1.3 Persistent failure to prosecute the Work in accordance with the Contract, and to insure its completion within the time, or any approved extension thereof, specified in this Contract,

17.4.1.4 Failure to remedy defective work condemned by the PM or designated representative,

17.4.1.5 Failure to pay subcontractors, laborers, materialmen and suppliers pursuant to Tex. Gov't Code Chapter 2251;

17.4.1.6 Persistent endangerment to the safety of labor or of the Work, including display of uncooperative, disruptive or threatening behavior,

17.4.1.7 Failure to resume the Work that has been discontinued within a reasonable number of days after written notice to do so,

17.4.1.8 Failure to supply or maintain statutory bonds or to maintain required insurance, pursuant to the Contract,

17.4.1.9 Any material breach or substantial violation of a provision of the Contract,

17.4.1.10 Contractor's insolvency, bankruptcy, or demonstrated financial inability to perform the Work.

17.4.2 Should TxDOT decide to terminate the employment of the Contractor under any of the provisions of the **Termination by TxDOT For Cause** provision of this Article, it will provide to the Contractor and its Surety, if Surety is required, written notice of the intent to declare the Contractor in default if the Contractor does not proceed as directed within ten (10) days after receipt of the notice.

17.4.3 Should the Contractor or its Surety, if Surety is required, after having received notice of intent to declare the Contractor in default, demonstrate to the satisfaction of TxDOT within the time frame set forth in the notice, remedy to the condition(s) upon which the notice was based, the notice shall be rescinded in writing by TxDOT. If so rescinded, the Work may continue without an extension of time or any increase in the Contract Sum related directly or indirectly to the remedy.

17.4.4 Failure by TxDOT to exercise the right to terminate in any instance or for any proper reason is not a waiver of the right to do so in any other instance or for any other proper reason.

17.4.5 If the Contractor or its Surety, if Surety is required, fails to demonstrate activities to remedy the condition(s) upon which the notice of intent was based, to the satisfaction of TxDOT and within the time frame set forth in the notice following receipt of notice, TxDOT will give written notice to the Contractor and Surety, if Surety is required, declare the Contractor to be in default of the Contract, terminate the employment of the Contractor and take possession of the site and of all materials, equipment, tools, construction equipment and machinery thereon owned by the Contractor. TxDOT shall also without violating the Contract, demand the Contractor's Surety, if Surety is required, complete the remaining Work in accordance with the terms of the original Contract subject to, but not limited to, the following:

17.4.5.1 The Surety, if Surety is required, becomes the Contractor in a takeover;

17.4.5.2 A completing Contractor will be considered a subcontractor of the Surety, if Surety is required;

17.4.5.3 TxDOT reserves the right to approve or reject proposed subcontractors. HUB's must continue to be used in accordance with the commitments previously approved in the HSP by TxDOT;

17.4.5.4 Work may resume after TxDOT receives and approves certificates of insurance as required by the Contract Documents. Certificates of insurance may be issued in the name of the completing Contractor;

17.4.5.5 The Surety, if Surety is required, is responsible for making every effort to expedite the resumption of the Work and completion of the Contract;

17.4.5.6 The completing Contractor may complete the Work utilizing the materials at the work location it deems suitable and acceptable subject to compliance with the provisions of the Contract Documents;

17.4.5.7 Time charges will continue until completion of the Contract;

17.4.5.8 Any costs incurred by TxDOT including, but not limited to, the cost of additional A/E services, other consultants, contract administration, liquidated damages, and any work or service of any type made necessary by such default or neglect will be the responsibility of the Surety. All costs associated with this work will be deducted from money due to the Surety. If the amount due TxDOT exceeds the sum that would have been payable under the Contract, the Surety will be liable and pay TxDOT the balance of these costs in excess of the Contract Sum. This obligation for payment survives the termination of the Contract.

17.4.6 In termination for cause the Contractor may be subject to sanctions under Title 43 Texas Administrative Code Chapter 9, Subchapter G.

17.4.7 The Surety's obligation for performance shall survive the termination of the Contract. Should the Surety fail to so demonstrate within thirty (30) days following receipt of termination notice to TxDOT's reasonable satisfaction that the condition or conditions upon which the notice of termination is based have been removed, corrected, or will not recur, TxDOT may, upon written notice to the Surety arrange for completion of the Work and pursue its legal remedies. TxDOT shall file suite for the cost incurred by TxDOT to complete the Work including, but not limited to, the cost of additional A/E services, other consultants, contract administration, and any work or service of any type made necessary by such default, corrections to the Work, or neglect.

17.4.7.1 In addition to any rights TxDOT may have against the Surety TxDOT reserves the right in termination for cause to take assignment of any and all contracts between the Surety, and its Subcontractors, vendors and suppliers. The PM or designated representative will promptly notify the Surety of the contracts, TxDOT elects to assume. Upon receipt of such notice, the Surety shall promptly take all steps necessary to affect such assignment.

17.4.8 If it is determined, after the Contractor is declared in default, that the Contractor was not in default, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of TxDOT as provided for in the **Termination for Convenience of TxDOT** provision under this Article.

17.5 **TERMINATION FOR CONVENIENCE OF TXDOT.** TxDOT reserves the right, without breach, to terminate the Contract prior to, or during the performance of the Work, for any reason. Upon such an occurrence, the following shall apply:

17.5.1 TxDOT will immediately notify the Contractor and the A/E in writing, specifying the reason for and the effective date of contract termination. Such notice may also contain instructions necessary for the protection, storage or decommissioning of incomplete work or systems, and for safety.

17.5.2 Upon receipt of the notice of termination, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due at that point in the Contract:

17.5.2.1 Stop all work.

17.5.2.2 Place no further subcontracts or orders for materials or services.

17.5.2.3 Terminate all subcontracts.

17.5.2.4 Cancel all materials and equipment orders as applicable.

17.5.2.5 Take action that is necessary to protect and preserve all property related to this Contract and materials, equipment and other property which is in the possession of the Contractor and for which TxDOT has paid the Contractor.

17.5.3 When the Contract is terminated for TxDOT's convenience, the Contractor may recover from TxDOT payment for all Work executed, including any additional work required pursuant to the notice of termination, and for any provable loss and reasonable expenses attributable to the Work resulting from such termination, but not for anticipated profits after the date of termination.

17.6 **TERMINATION BY CONTRACTOR**. If the Work is stopped for a period of ninety (90) days under an order of any court or other public authority having jurisdiction, or as a result of an act of government, such as a declaration of a national emergency making materials unavailable, through no act or fault of the Contractor or a Subcontractor or their agents or employees or any other persons performing any of the Work under a contract with the Contractor, then the Contractor may, upon thirty (30) additional days' written notice to the PM or designated representative, terminate the Contract and recover from TxDOT payment for all Work previously executed and for any provable loss and reasonable expenses attributable to the Work resulting prior to such termination, but not for anticipated profits after the date of notice by the Contractor. If the cause of the work stoppage is removed prior to the end of the thirty (30) day notice period, the Contractor may not terminate the Contract.

17.7 **SETTLEMENT ON TERMINATION.** When the Contract is terminated for any reason, the Contractor shall, at any time prior to sixty (60) days after the effective date of termination, submit a final termination settlement proposal to TxDOT based upon recoverable costs as provided herein. If the Contractor fails to submit the proposal within the time allowed, TxDOT may determine the amount due to the Contractor because of the termination and TxDOT will pay the determined amount to the Contractor. All settlements on termination shall be administered as a Change Order.

Article 18 Dispute Resolution

18.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

18.2 **CONTRACTOR DISPUTES**. It is TxDOT's goal to have a dispute settled at the District / Office / Division, depending on the type of contract, level prior to elevating it to the Contract Claim Committee.

18.3 **UNRESOLVED CONTRACTOR DISPUTES.** The Alternate Dispute Resolution Process is authorized under Texas Government Code Chapter 2009. The Alternative Dispute Resolution Process shall be used by TxDOT and the Contractor to attempt to resolve any claim made by the Contractor or TxDOT.

18.3.1 **Contractor Claim**. A claim filed by the Contractor shall follow the Contract Claim Procedure as set forth in Texas Administrative Code (TAC) Title 43, Part 1, Chapter 9, Subchapter A, Rule §9.2.

18.3.1.1 Only the Contractor (prime contractor) shall submit a claim to begin a claim proceeding.

18.3.1.2 The prime contractor agrees to file a claim only after completion of the contract or when required for orderly performance of the contract.

18.3.1.3 The Prime Contractor shall file a claim no later than one year after the earlier of: the date TxDOT issues notice to the Contractor that it is in default, or the date TxDOT terminates the Contract; or the date TxDOT issues Final Acceptance of the Project.

18.3.1.4 After a claim proceeding has begun TxDOT may make a counter claim.

18.3.1.5 A claim filed by the prime contractor must be considered by the Contract Claim Committee. After a committee decision is issued, the Contractor can file with TxDOT's Executive Director a written petition requesting an administrative hearing.

18.3.2 **Owner Claim**. TAC 43, §9.2 does not abrogate TxDOT's authority to file a claim in a court of competent jurisdiction. The procedure for TxDOT to file a claim in a court of competent jurisdiction, including the deadline to file a claim, is set by other law.

18.4 **CONDITION PRECEDENT TO FORMAL ADMINISTRATIVE HEARING.** Compliance by the Contractor with TAC 43, §9.3 Contract Claim Procedure is a condition precedent to the filing of a contested case proceeding under Government Code Chapter 2001.

18.5 **CONDITION PRECEDENT TO SEEKING CONSENT TO SUE.** Compliance with the contested case process provided in Government Chapter 2001 is a condition precedent to seeking consent to sue from the Legislature under Chapter 107 of the Texas Civil Practices and Remedies Code.

18.6 **CONTINUED PERFORMANCE.** The pendency of a claim or claims does not authorize any suspension of performance by the Contractor nor relieve the Contractor from any of its obligations, in whole or in part.

18.7 **ACCESS TO DOCUMENTS.** The Contractor agrees that TxDOT and any of its duly authorized representatives shall have access and the right to examine, during normal business hours, any books, documents, papers, and records of the Contractor related to the Project. Further, the Contractor agrees to include this provision in all its subcontracts. The period of access and examination described herein also relates to appeals under this Article of the Contract, litigation, or the settlement of claims arising out of the performance of this Contract. The period of access and examination shall continue until final disposition of such claims, appeals or litigation.

Article 19 Miscellaneous

19.1 **RESOLUTION OF CONFLICTS IN THE DOCUMENTS.** In the event of conflict between the requirements of this Article and the Specifications the more restrictive shall apply.

19.2 **SPECIAL CONDITIONS.** When the Work contemplated by TxDOT is of such a character that the foregoing Uniform General Conditions of the Contract cannot adequately cover necessary and additional contractual relationships, the Contract may include Special Conditions as described below.

19.2.1 Special Conditions shall relate to a particular project, be peculiar to that project, and may alter or expand any of the Uniform General Conditions.

19.3 **STANDARD SPECIFICATIONS**. When the Work contemplated by TxDOT requires the use of *Standard Specifications*, as defined in *Article 1*, for construction of elements of the Work, the Measurement and Payment sections of each *Standard Specifications* Item Number referenced are modified as described below. The term "TxDOT Item Number" or "Item Number", if used, shall have the same meaning as *Standard Specifications* Item Number.

19.3.1 **Measurement.** The Measurement section of the *Standard Specifications* Item Number is voided and the Item will be measured on a percentage of Work completed and materials stored corresponding to the Schedule of Values Work classification under which the Item is included.

19.3.2 **Payment.** The Payment section of the *Standard Specifications* Item Number is voided and the payment for the Item will be made on a percentage of Work completed and materials stored corresponding to the Schedule of Values Work classification under which the Item is included

19.4 **PERSONAL LIABILITY OF PUBLIC OFFICIALS**. TxDOT employees are agents and representatives of the State and will incur no liability, personal or power or authority granted under the Contract.

19.5 **ASSIGNMENT OF CONTRACT.** Contractor shall not assign, sell, transfer, or otherwise dispose of the Contract or any portion, rights, title, or interest (including claims) without the approval of the Commission or designated representative. TxDOT must deem any proposed assignment justified and legally acceptable before the assignment may be approved. Any assignment, without TxDOT's approval, is void.

19.6 **RESPONSIBILITY FOR DAMAGE CLAIMS. THE CONTRACTOR AGREES TO INDEMNIFY AND SAVE HARMLESS THE STATE AND ITS AGENTS AND EMPLOYEES FROM ALL SUITES, ACTION OR CLAIMS AND FROM ALL LIABILITY AND DAMAGES FOR ANY INJURY OR DAMAGE TO ANY PERSON OR PROPERTY DUE TO THE CONTRACTOR'S NEGLIGENCE IN THE PERFORMANCE OF THE WORK AND FROM ANY CLAIMS ARISING OR AMOUNTS RECOVERED UNDER ANY LAWS, INCLUDING WORKERS' COMPENSATION AND THE TEXAS TORT CLAIMS ACT. INDEMNITY AND SAVE HARMLESS THE STATE AND ASSUME RESPONSIBILITY FOR ALL DAMAGES AND INJURY TO PROPERTY OF ANY CHARACTER OCCURRING DURING THE PROSECUTION OF THE WORK RESULTING FROM ANY ACT, OMISSION, NEGLECT OR MISCONDUCT ON THE CONTRACTOR'S PART IN THE MANNER OR METHOD OF EXECUTING THE WORK; FROM FAILURE TO PROPERLY EXECUTE THE WORK; OR FROM DEFECTIVE WORK OR MATERIALS. THE CONTRACTOR SHALL NOT BE RELEASED FROM THESE RESPONSIBILITIES UNTIL ALL CLAIMS HAVE BEEN SETTLED AND SUITABLE EVIDENCE TO THAT EFFECT TENDERED TO THE STATE.**

19.7 **ASSERTION OF CLAIM.** If the Contractor asserts any claim or brings any type of legal action (including an Original Action, Third Party Action, or Cross Claim) against any Commissioner, or individual employee of TxDOT for any cause of action or claim for alleged negligence arising from the Contract, the Contractor will be ineligible to bid on any contract with TxDOT during the pendency of the claim or legal action.

19.7.1 Individual owners of a contracting firm are treated the same as a contractor. Therefore, the requirement is met when owners of a contracting firm bring a claim of legal action against a TxDOT employee.

CHILD SUPPORT STATEMENT

Under Section 231.006, Family Code, the vendor or applicant certifies that the individual or business entity named in this contract, bid, or application is not ineligible to receive the specified grant, loan, or payment and acknowledges that this contract may be terminated and payment may be withheld if this certification is inaccurate.

Texas Department of Transportation

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E-Verify System - Instructions

1. If your company is not already registered, register here: https://www.uscis.gov/e-verify/e-verify-enrollment-page
2. Upon registration, the system automatically creates the "E-Verify Memorandum of Understanding for Employers." Note: If you need technical support, contact E-Verify https://www.uscis.gov/e-verify/customer-support/contact-e-verify
3. Access your company's "E-Verify Memorandum of Understanding for Employers" and save the file as a PDF.
4. As affirmation of your company's compliance with SB 312, you will need to submit the "E-Verify Memorandum of Understanding for Employers".

Failure to submit the "E-Verify Memorandum of Understanding for Employers" will result in your proposal being rejected.

Once a contractor has complied with these requirements, TxDOT will add the company name to the list of Contractors Confirmed as Participating in E-Verify to identify prime contractors and subcontractors who have provided the requested documentation to confirm participation in the E-Verify system.

For more information, contact the Support Services Division at (512) 416-2458 or email SSD_ContractLettings@txdot.gov

E-VERIFY CERTIFICATION

Pursuant to Texas Transportation Code §223.051, all TxDOT contracts for construction, maintenance, or improvement of a highway must include a provision requiring Contractors and subcontractors to use the U.S. Department of Homeland Security's E-Verify system to determine employment eligibility. By signing the contract, the Contractor certifies that prior to the award of the Contract:

- the Contractor has registered with and will, to the extent permitted by law, utilize the United States Department of Homeland Security's E-Verify system during the term of the Contract to determine the eligibility of all persons hired to perform duties within Texas during the term of the agreement; and
- the Contractor will require that all subcontractors also register with and, to the extent permitted by law, utilize the United States Department of Homeland Security's E-Verify system during the term of the subcontract to determine the eligibility of all persons hired to perform duties within Texas during the term of the agreement.

Violation of this requirement constitutes a material breach of the Contract, subjects a subcontractor to removal from the Contract, and subjects the Contractor or subcontractors to possible sanctions in accordance with Title 43, Texas Administrative Code, Chapter 10, Subchapter F, "Sanctions and Suspension for Ethical Violations by Entities Doing Business with the Department."

CERTIFICATION TO NOT BOYCOTT ISRAEL

Pursuant to Texas Government Code §2271.002, the Department must include a provision requiring a written verification affirming that the Contractor does not boycott Israel and will not boycott Israel during the term of the contract. This provision applies to a contract that:

1) is with a Contractor that is not a sole proprietorship,
2) is with a Contractor with 10 or more full-time employees, and
3) has a value of $100,000 or more.

By signing the contract, the Contractor certifies that it does not boycott Israel and will not boycott Israel during the term of this contract.

Violation of this certification may result in action by the Department.

Joint Workforce Safety Plan: COVID-19

COVID-19 Guidance for the Transportation Industry

As we continue to meet the transportation needs of the State of Texas, our industry partners – to include consultants, contractors, FHWA and TxDOT – expect all parties to abide by the COVID-19 safety guidelines issued from the Centers for Disease Control and Prevention (CDC), Texas Department of State Health Services (DSHS) and the Occupational Health and Safety Administration (OSHA).

Industry partners have taken steps to prevent the spread of COVID-19 by implementing guidelines and policies including restricted travel, limiting "in person" meetings, limiting the number of people at work in the office and the project environment, and exercising enhanced personal hygiene practices.

As a unified approach to prevent the spread, below are guidelines and practices agreed to by industry partners, which will be implemented at their own expense. These guidelines will be used on TxDOT projects in a reasonable and practicable manner.

Employee Health and Safety:

- Any employee who is sick or has any of the COVID-19 symptoms such as fever, coughing, or shortness of breath will stay home.
- For guidance on confirmed positive tests for COVID-19 or exposure to someone who tests positive, refer to the most recent version of the "COVID-19 Guidance for Employees/Leadership on TxDOT Projects" located on the last page of this plan.
- "High Health Risk" employees such as those with chronic diseases, respiratory disorders, or those who possess immunodeficiencies can discuss alternate work arrangements with their supervisor or HR representative, or take leave according to their company's policies.
- Employees who show or report symptoms of acute respiratory illness (cough, shortness of breath, etc.) will immediately be sent home.

Personal Hygiene:

- Wash hands often with soap and water for at least 20 seconds, especially after going to the bathroom; before eating; and after blowing your nose, coughing, or sneezing.
    - *If soap and water are not available, use an alcohol-based hand sanitizer with at least 60% alcohol*.
- Cover cough or sneeze with a tissue, then throw the tissue in the trash.
- If a tissue is not available, cough and sneeze into upper shirt sleeve, completely covering mouth and nose.

- Avoid touching your eyes, nose, mouth or other parts of your face.

Cleaning and Disinfecting:

- Wash stations and/or hand sanitizer will be provided on each project site for use by all employees.
- Surfaces and objects that are frequently touched by multiple people will be cleaned throughout the day. These surfaces include the following:
    - Office/Buildings: door knobs, light switches, phones, computers, keyboards, copy machines, elevator buttons, toilets, sinks, countertops, paper towel dispensers, desktop surfaces, hand rails, vending machines, counter tops, tables, cabinets, etc.
    - Shop Yard/Jobsite: equipment door handles, keys, gear shifters, steering wheels, operator controls, fuel pump dispensers, etc.
- Sanitize/disinfect facilities and work areas after persons suspected/confirmed to have COVID-19 have been in the facility or work area.
    - It is recommended to close off areas used by these persons and wait as long as practical before beginning cleaning and disinfecting as a means of minimizing potential exposure to respiratory droplets.
        - Cleaning staff should safely clean and disinfect all areas used by these persons focusing especially on frequently touched surfaces.

General Guidance:

- Practice “social distancing” as much as possible.
    - All personnel have the responsibility to remind each other to stay at least 6 feet apart.
- Communicate the COVID-19 precautions/guidelines in both English and Spanish (a bilingual communications link is included in the resource list of this document).
- Increase proactive communication measures between all parties regarding schedule, daily activities, etc. to reduce/minimize worker exposure.
- Minimize on-site personnel such as subcontractors, work crews, QC personnel, and inspection staff to those required for that day’s activities.
    - If work is postponed or cancelled, immediately notify appropriate parties.
- Do not congregate during lunch or breaks. Practice social distancing and staggered lunch breaks to eliminate group gatherings.
- The first line of communication should be phone, rather than in-person.
- Use of video conferencing/conference calls is the preferable method for conducting discussion-based meetings.

- If an in-person meeting is absolutely required and cannot be rescheduled or attended remotely, the meeting is limited to a maximum of 10 people while maintaining social distancing of 6 feet or more between all individuals and meeting outside whenever possible.
- No handshakes.

- Do not share iPads, tablets, pens, or clipboards for signing or any other purpose.
- Take pictures as proof of attendance at status meetings, tailgate meetings, etc.
- Sharing of Personal Protective Equipment (PPE) is strictly prohibited.
- For Vehicles, Equipment, and Tools:
  - Limit the number of people riding in a vehicle together.
  - Wipe down and disinfect shared vehicles after each shift.
  - As much as possible, do not share tools or equipment.
    - If a tool or piece of equipment must be shared, the parts of it that are touched should be sanitized between uses.

Return to Work:

- In accordance with CDC guidance, the following criteria must be followed for an employee with a positive test result to return to work:
  - At least 14 days must have passed from positive test notification; ***and***
  - At least 3 days (72 hours) must have passed since recovery defined as resolution of fever without the use of fever-reducing medications and improvement in respiratory symptoms (e.g., cough, shortness of breath); ***and***,
  - At least 7 days must have passed since symptoms first appeared.

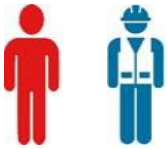
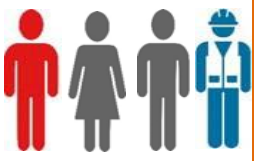
Additional Resources:

- Texas Department of State Health Services
  - https://www.dshs.texas.gov/coronavirus/
- TDSHS Bilingual Communication Tools
  - https://www.dshs.texas.gov/coronavirus/tools.aspx
- Centers for Disease Control and Prevention
  - https://www.cdc.gov/coronavirus/2019-nCoV/index.html
- What to do if you are sick
  - https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/steps-when-sick.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fabout%2Fsteps-when-sick.html

- Interim Guidance for Businesses and Employers to Plan and Respond to COVID-19
    - https://www.cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fspecific-groups%2Fguidance-business-response.html
- OSHA Guidance on Preparing Workplaces for COVID-19
    - https://www.osha.gov/SLTC/covid-19/controlprevention.html
    - https://www.osha.gov/Publications/OSHA3990.pdf

All parties agree to the guidelines in this plan to support continued work while limiting exposure to COVID-19. A contractor, consultant, or FHWA and TxDOT staff who does not agree to reasonably and practically follow the guidance herein will not be allowed to work on the project.

COVID-19 Guidance for Employees/Leadership on TxDOT Projects

Confirmed Positive (+) Test		Safety/Leadership Direction		
		Primary Employee	**Crew / Work Group** *Exposure within 6' and longer than 10 minutes*	**Project Site** *No exposure within 6' and longer than 10 minutes*
Employee		Employee notifies supervisor via phone Employee stays home for required self-quarantine period	Prime Contractor/AE advises of (+) test* Co-workers & exposed personnel sent home to satisfy the 14-day self-quarantine period Sanitize work area/equipment/tools	Advise of (+) test * Unexposed site personnel may continue onsite work or follow their company policy to satisfy the 14-day self-quarantine period Continue hygiene & disinfecting measures
Direct Contact *Interaction with an infected person within 6' and longer than 10 minutes*		Employee removed from project site and follows their company policy to satisfy the 14-day self-quarantine period	Advise of (+) test * Site personnel may continue onsite work or follow their company policy to satisfy the 14-day self-quarantine period Continue hygiene & disinfecting measures	Continue hygiene & disinfecting measures
Secondary Contact		Employee may continue onsite work or follow their company policy to satisfy the 14-day self-quarantine period Continue hygiene & disinfecting measures	Continue hygiene & disinfecting measures	Continue hygiene & disinfecting measures
Two or more Persons Removed from Contact		Continue hygiene & disinfecting measures	Continue hygiene & disinfecting measures	Continue hygiene & disinfecting measures
*** Notification Protocol** **(Comply with HIPAA & ADA confidentiality requirements)**	**TxDOT or FHWA Representative Tests (+)**	TxDOT notifies prime contractor's PM, FHWA, & CEI or testing consultant firms working for TxDOT Prime contractor notifies other contractors and suppliers with exposed employees		
	Contractor or Supplier Employee Tests (+)	Prime contractor notifies TxDOT and all other contractors and suppliers with exposed employees TxDOT notifies FHWA and any consultant firms working for TxDOT		

Special Provision to Item 000
Special Labor Provisions for State Projects

1. GENERAL

This is a "Public Works" Project, as provided under Government Code Title 10, Chapter 2258, "Prevailing Wage Rates," and is subject to the provisions of the Statute. No provisions in the Contract are intended to be in conflict with the provisions of the Statute.

The Texas Transportation Commission has ascertained and indicated in the special provisions the regular rate of per diem wages prevailing in each locality for each craft or type of worker. Apply the wage rates contained in the specifications as minimum wage rates for the Contract.

2. MINIMUM WAGES, HOURS AND CONDITIONS OF EMPLOYMENT

All workers necessary for the satisfactory completion of the work are within the purview of the Contract.

Whenever and wherever practical, give local citizens preference in the selection of labor.

Do not require any worker to lodge, board or trade at a particular place, or with a particular person as a condition of employment.

Do not charge or accept a fee of any from any person who obtains work on the project. Do not require any person who obtains work on the project to pay any fee to any other person or agency obtaining employment for the person on the project.

Do not charge for tools or equipment used in connection with the duties performed, except for loss or damage of property. Do not charge for necessary camp water.

Do not charge for any transportation furnished to any person employed on the project.

The provisions apply where work is performed by piece work, station work, etc. The minimum wage paid will be exclusive of equipment rental on any shipment which the worker or subcontractor may furnish in connection with his work.

Take responsibility for carrying out the requirements of this specification and ensure that each subcontractor working on the project complies with its provisions.

Any form of subterfuge, coercion or deduction designated to evade, reduce or discount the established minimum wage scales will be considered a violation of the Contract.

The Fair Labor Standards Acts (FLSA) established one and one-half (1-1/2) pay for overtime in excess of 40 hours worked in 1 week. Do not consider time consumed by the worker in going to and returning from the place of work as part of the hours of work. Do not require or permit any worker to work in excess of 40 hours in 1 week, unless the worker receives compensation at a rate not less than 1-1/2 times the basic rate of pay for all hours worked in excess of 40 hours in the workweek.

The general rates of per diem wages prevailing in this locality for each class and type of workers whose services are considered necessary to fulfill the Contract are indicated in the special provisions, and these rates govern as minimum wage rates on this Contract. A penalty of $60.00 per calendar day or portion of a calendar day for each worker that is paid less than the stipulated general rates of per diem wages for any work done under the Contract will be deducted. The Department, upon receipt of a complaint by a worker,

will determine within 30 days whether good cause exists to believe that the Contractor or a subcontractor has violated wage rate requirements and notify the parties involved of the findings. Make every effort to resolve the alleged violation within 14 days after notification. The next alternative is submittal to binding arbitration in accordance with the provisions of the Texas General Arbitration Act (Art. 224 et seq., Revised Statutes).

Notwithstanding any other provision of the Contract, covenant and agree that the Contractor and its subcontractors will pay each of their employees and contract labor engaged in any way in work under the Contract, a wage not less than what is generally known as the "federal minimum wage" as set out in 29 U.S.C. 206 as that Statute may be amended from time to time.

Pay any worker employed whose position is not listed in the Contract, a wage not less than the per diem wage rate established in the Contract for a worker whose duties are most nearly comparable.

3. RECORD AND INSPECTIONS

Keep copies of weekly payrolls for review. Require subcontractors to keep copies of weekly payrolls for review. Show the name, occupation, number of hours worked each day and per diem wage paid each worker together with a complete record of all deductions made from such wages. Keep records for a period of 3 years from the date of completion of the Contract.

Where the piece-work method is used, indicate on the payroll for each person involved:

- Quantity of piece work performed.
- Price paid per piece-work unit.
- Total hours employed.

The Engineer may require the Contractor to file an affidavit for each payroll certifying that payroll is a true and accurate report of the full wages due and paid to each person employed.

Post or make available to employees the prevailing wage rates from the Contract. Require subcontractors to post or make available to employees the prevailing wage rates from the Contract.

Special Provision 000
Notice of Contractor Performance Evaluations

1. GENERAL

In accordance with Texas Transportation Code §223.012, the Director of Support Services Division for building contracts will evaluate Contractor performance based on quality, safety, and timeliness of the project.

2. DEFINITIONS

2.1. **Project Recovery Plan (PRP)**—a formal, enforceable plan developed by the Contractor, in consultation with the Director of Support Services Division, that documents the cause of noted quality, safety, and timeliness issues and specifies how the Contractor proposes to correct project-specific performance deficiencies.

In accordance with Title 43, Texas Administrative Code (TAC), §9.23, the Director of Support Services Division will request a PRP if the Contractor's performance on a project is below the Department's acceptable standards and will monitor the Contractor's compliance with the established plan.

2.2. **Corrective Action Plan (CAP)**—a formal, enforceable plan developed by the Contractor, and proposed for adoption by the Support Services Division, that documents the cause of noted quality, safety, and timeliness issues and specifies how the Contractor proposes to correct statewide performance deficiencies.

In accordance with 43 TAC §9.23, the Division will request a CAP if the average of the Contractor's statewide final evaluation scores falls below the Department's acceptable standards for the review period and will monitor the Contractor's compliance with the established plan.

3. CONTRACTOR EVALUATIONS

In accordance with Title 43, Texas Administrative Code (TAC) §9.23, the Chief Administrative Officer for building contracts will schedule evaluations at the following intervals, at minimum:

- Interim evaluations—at or within 30 days after the anniversary of the notice to proceed, for Contracts extending beyond 1 yr., and
- Final evaluation—upon project closeout.

In case of a takeover agreement, neither the Surety nor its performing Contractor will be evaluated.

In addition to regularly scheduled evaluations, the Chief Administrative Officer may schedule an interim evaluation at any time to formally communicate issues with quality, safety, or timeliness. Upon request, work with the Chief Administrative Officer to develop a PRP to document expectations for correcting deficiencies.

Comply with the PRP as directed. Failure to comply with the PRP may result in additional remedial actions available to the Chief Administrative Officer under the Uniform General Conditions. Failure to meet a PRP to the Chief Administrative Officer's satisfaction may result in immediate referral to the Performance Review Committee for consideration of further action against the Contractor.

The Chief Administrative Officer will consider and document any events outside the Contractor's control that contributed to the failure to meet performance standards or comply with a PRP, including consideration of sufficient time.

Follow the escalation ladder if there is a disagreement regarding an evaluation or disposition of a PRP. The Contractor may submit additional documentation pertaining to the dispute. The Chief Administrative Officer's decision on a Contractor's evaluation score and recommendation of action required in a PRP or follow up for non-compliance is final.

4. DIVISION OVERSIGHT

Upon request of the Support Services Division, develop and submit for Division approval a proposed CAP to document expectations for correcting deficiencies in the performance of projects statewide.

Comply with the CAP as directed. The CAP may be modified at any time up to completion or resolution after written approval of the premise of change from the Division. Failure to meet an adopted or revised adopted CAP to the Division's satisfaction within 120 days will result in immediate referral to the Performance Review Committee for consideration of further action against the Contractor.

The Division will consider and document any events outside the Contractor's control that contributed to the failure to meet performance standards or comply with a CAP, including consideration of sufficient time and associated costs as appropriate.

5. PERFORMANCE REVIEW COMMITTEE

The Performance Review Committee, in accordance with 43 TAC §9.24, will review at minimum all final evaluations, history of compliance with PRPs, any adopted CAPs including agreed modifications, any information about events outside a Contractor's control contributing to the Contractor's performance, and any documentation submitted by the Contractor and may recommend one or more of the following actions:

- take no action,
- reduce the Contractor's bidding capacity,
- prohibit the Contractor from bidding on one or more projects,
- immediately suspend the Contractor from bidding for a specified period of time, by reducing the Contractor's bidding capacity to zero, or
- prohibit the Contractor from being awarded a Contract on which they are the apparent low bidder.

The Deputy Executive Director will determine any further action against the Contractor.

6. APPEALS PROCESS

In accordance with 43 TAC §9.25, the Contractor may appeal remedial actions determined by the Deputy Executive Director.

Special Provision to Item 506

Temporary Erosion, Sedimentation, and Environmental Controls

Item 506, "Temporary Erosion, Sedimentation, and Environmental Controls," of the Standard Specifications is amended with respect to the clauses cited below. No other clauses or requirements of this Item are waived or changed.

Article 506.1., "Description." The second paragraph is voided and replaced by the following.

Contractor is considered primary operator to have day-to-day operational control as defined in TPDES GP TXR150000.

1.1. For projects with soil disturbance of less than 1 acre, no submittal to TCEQ will be required but Contractor will follow SWP3. For projects with soil disturbance of 1 acre to less than 5 acres a small site notice will be posted at the site. For projects with soil disturbance of 5 acres or more a notice of intent (NOI) is required and a large site notice posted at site. Postings will be in accordance with TPDES GP TXR150000. Postings not associated with project specific locations will be in same location as Department's postings.

1.2. Notice of Intent (NOI). Submit a NOI, if applicable, with the TCEQ under the TPDES GP TXR150000 at least 7 days prior to commencement of construction activities at the project site. Provide a signed copy to the Engineer and any other MS4 operators at the time of submittal. The Department will submit their NOI prior to contractor submission and will provide a copy for Contractor's use in completing the Contractor's NOI form.

1.3. Notice of Change (NOC). Upon concurrence of the Engineer, submit a NOC, if applicable, to the TCEQ within 14 days of discovery of a change or revision to the NOI as required by the TPDES GP TXR150000. Provide a signed copy of the NOC to the Engineer and any other MS4 operators at the time of submittal.

1.4. Notice of Termination (NOT). Upon concurrence of the Engineer, submit a NOT, if applicable, to the TCEQ within 30 days of the Engineer's approval that 70% native background vegetative cover is met or equivalent permanent stabilization have been employed in accordance with the TPDES GP TXR 150000. Provide a signed copy of the NOT to the Engineer and any other MS4 operators at the time of submittal.

Section 506.3.3., "Training," is supplemented by the following:

Training is provided by the Department at no cost to the Contractor and is valid for 3 yr. from the date of completion. The Engineer may require the following training at a frequency less than 3 yr. based on environmental needs:

- "Environmental Management System: Awareness Training for the Contractor" (English and Spanish) (Approximate running time 20 min.), and
- "Storm Water: Environmental Requirements During Construction" (English and Spanish) (Approximate running time 20 min.).

The contractor responsible person environmental (CRPE), alternate CRPE designated for emergencies, Contractor's superintendent, Contractor, and subcontractor lead personnel involved in soil disturbing or SWP3 activities must enroll in and complete the training listed below and provide the certificate of completion to the Engineer before performing soil disturbing or SWP3 activities on the project. Training is provided by a third party and is valid for 3 years from the date shown on the Certificate of Completion. Coordinate enrollment as prescribed by the Department and pay associated fees for the following training:

- "Revegetation During Construction"
- "Construction General Permit Compliance," and

- "Construction Stage Gate Checklist (CSGC)."

Training and associated fee will not be measured or paid for directly but are subsidiary to this Item.

Item 506

Temporary Erosion, Sedimentation, and Environmental Controls

1. DESCRIPTION

Install, maintain, and remove erosion, sedimentation, and environmental control measures to prevent or reduce the discharge of pollutants in accordance with the Storm Water Pollution Prevention Plan (SWP3) on the plans and the Texas Pollutant Discharge Elimination System (TPDES) General Permit TXR150000. Control measures are defined as Best Management Practices used to prevent or reduce the discharge of pollutants. Control measures include, but are not limited to, rock filter dams, temporary pipe slope drains, temporary paved flumes, construction exits, earthwork for erosion control, pipe, construction perimeter fence, sandbags, temporary sediment control fence, biodegradable erosion control logs, vertical tracking, temporary or permanent seeding, and other measures. Erosion and sediment control devices must be selected from the *Erosion Control Approved Products* or *Sediment Control Approved Products* lists. Perform work in a manner to prevent degradation of receiving waters, facilitate project construction, and comply with applicable federal, state, and local regulations. Ensure the installation and maintenance of control measures is performed in accordance with the manufacturer's or designer's specifications.

Provide the Contractor Certification of Compliance before performing SWP3 or soil disturbing activities. By signing the Contractor Certification of Compliance, the Contractor certifies they have read and understand the requirements applicable to this project pertaining to the SWP3, the plans, and the TPDES General Permit TXR150000. The Contractor is responsible for any penalties associated with non-performance of installation or maintenance activities required for compliance. Ensure the most current version of the certificate is executed for this project.

2. MATERIALS

Furnish materials in accordance with the following:

- Item 161, "Compost,"
- Item 432, "Riprap," and
- Item 556, "Pipe Underdrains."

2.1. **Rock Filter Dams.**

2.1.1. **Aggregate.** Furnish aggregate with approved hardness, durability, cleanliness, and resistance to crumbling, flaking, and eroding. Provide the following:

- Types 1, 2, and 4 Rock Filter Dams. Use 3 to 6 in. aggregate.
- Type 3 Rock Filter Dams. Use 4 to 8 in. aggregate.

2.1.2. **Wire.** Provide minimum 20 gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams. Type 4 dams require:

- a double-twisted, hexagonal weave with a nominal mesh opening of 2-1/2 × 3-1/4 in.;
- minimum 0.0866 in. steel wire for netting;
- minimum 0.1063 in. steel wire for selvages and corners; and
- minimum 0.0866 in. for binding or tie wire.

2.1.3. **Sandbag Material.** Furnish sandbags meeting Section 506.2.8., "Sandbags," except that any gradation of aggregate may be used to fill the sandbags.

2.2. **Temporary Pipe Slope Drains**. Provide corrugated metal pipe, polyvinyl chloride (PVC) pipe, flexible tubing, watertight connection bands, grommet materials, prefabricated fittings, and flared entrance sections that conform to the plans. Recycled and other materials meeting these requirements are allowed if approved.

Furnish concrete in accordance with Item 432, "Riprap."

2.3. **Temporary Paved Flumes**. Furnish asphalt concrete, hydraulic cement concrete, or other comparable non-erodible material that conforms to the plans. Provide rock or rubble with a minimum diameter of 6 in. and a maximum volume of 1/2 cu. ft. for the construction of energy dissipaters.

2.4. **Construction Exits**. Provide materials that meet the details shown on the plans and this Section.

2.4.1. **Rock Construction Exit**. Provide crushed aggregate for long- and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft or flaky materials, and organic and injurious matter. Use 4- to 8-in. aggregate for Type 1. Use 2- to 4-in. aggregate for Type 3.

2.4.2. **Timber Construction Exit**. Furnish No. 2 quality or better railroad ties and timbers for long-term construction exits, free of large and loose knots and treated to control rot. Fasten timbers with nuts and bolts or lag bolts, of at least 1/2 in. diameter, unless otherwise shown on the plans or allowed. Provide plywood or pressed wafer board at least 1/2 in. thick for short-term exits.

2.4.3. **Foundation Course**. Provide a foundation course consisting of flexible base, bituminous concrete, hydraulic cement concrete, or other materials as shown on the plans or directed.

2.5. **Embankment for Erosion Control**. Provide rock, loam, clay, topsoil, or other earth materials that will form a stable embankment to meet the intended use.

2.6. **Pipe**. Provide pipe outlet material in accordance with Item 556, "Pipe Underdrains," and details shown on the plans.

2.7. **Construction Perimeter Fence**.

2.7.1. **Posts**. Provide essentially straight wood or steel posts that are at least 60 in. long. Furnish soft wood posts with a minimum diameter of 3 in., or use nominal 2 × 4 in. boards. Furnish hardwood posts with a minimum cross-section of 1-1/2 × 1-1/5 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.25 lb. per foot.

2.7.2. **Fence**. Provide orange construction fencing as approved.

2.7.3. **Fence Wire**. Provide 14 gauge or larger galvanized smooth or twisted wire. Provide 16 gauge or larger tie wire.

2.7.4. **Flagging**. Provide brightly-colored flagging that is fade-resistant and at least 3/4 in. wide to provide maximum visibility both day and night.

2.7.5. **Staples**. Provide staples with a crown at least 1/2 in. wide and legs at least 1/2 in. long.

2.7.6. **Used Materials**. Previously used materials meeting the applicable requirements may be used if approved.

2.8. **Sandbags**. Provide sandbag material of polypropylene, polyethylene, or polyamide woven fabric with a minimum unit weight of 4 oz. per square yard, a Mullen burst-strength exceeding 300 psi, and an ultraviolet stability exceeding 70%.

Use natural coarse sand or manufactured sand meeting the gradation given in Table 1 to fill sandbags. Filled sandbags must be 24 to 30 in. long, 16 to 18 in. wide, and 6 to 8 in. thick.

Table 1
Sand Gradation

Sieve Size	Retained (% by Weight)
#4	Maximum 3%
#100	Minimum 80%
#200	Minimum 95%

Aggregate may be used instead of sand for situations where sandbags are not adjacent to traffic. The aggregate size must not exceed 3/8 in.

2.9. **Temporary Sediment Control Fence.** Provide a net-reinforced fence using woven geo-textile fabric. Logos visible to the traveling public will not be allowed.

2.9.1. **Fabric.** Provide fabric materials in accordance with DMS-6230, "Temporary Sediment Control Fence Fabric."

2.9.2. **Posts.** Provide essentially straight wood or steel posts with a minimum length of 48 in., unless otherwise shown on the plans. Furnish soft wood posts at least 3 in. in diameter, or use nominal 2 × 4 in. boards. Furnish hardwood posts with a minimum cross-section of 1-1/2 × 1-1/2 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.25 lb. per foot.

2.9.3. **Net Reinforcement.** Provide net reinforcement of at least 12.5 gauge (SWG) galvanized welded wire mesh, with a maximum opening size of 2 × 4 in., at least 24 in. wide, unless otherwise shown on the plans.

2.9.4. **Staples.** Provide staples with a crown at least 3/4 in. wide and legs 1/2 in. long.

2.9.5. **Used Materials.** Use recycled material meeting the applicable requirements if approved.

2.10. **Biodegradable Erosion Control Logs.**

2.10.1. **Core Material.** Furnish core material that is biodegradable or recyclable. Use compost, mulch, aspen excelsior wood fibers, chipped site vegetation, agricultural rice or wheat straw, coconut fiber, 100% recyclable fibers, or any other acceptable material unless specifically called out on the plans. Permit no more than 5% of the material to escape from the containment mesh. Furnish compost meeting the requirements of Item 161, "Compost."

2.10.2. **Containment Mesh.** Furnish containment mesh that is 100% biodegradable, photodegradable, or recyclable such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material.

Furnish biodegradable or photodegradable containment mesh when log will remain in place as part of a vegetative system.

Furnish recyclable containment mesh for temporary installations.

2.10.3. **Size.** Furnish biodegradable erosion control logs with diameters shown on the plans or as directed. Stuff containment mesh densely so logs do not deform.

3. QUALIFICATIONS, TRAINING, AND EMPLOYEE REQUIREMENTS

3.1. **Contractor Responsible Person Environmental (CRPE) Qualifications and Responsibilities.** Provide and designate in writing at the preconstruction conference a CRPE and alternate CRPE who have overall responsibility for the storm water management program. The CRPE will implement storm water and erosion control practices; will oversee and observe storm water control measure monitoring and management; will monitor the project site daily and produce daily monitoring reports as long as there are BMPs in place or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES General Permit TXR150000. During time suspensions when work is not occurring or on contract non-work days, daily inspections are not required unless a rain event has occurred. The CRPE will provide recommendations on

how to improve the effectiveness of control measures. Attend the Department's preconstruction conference for the project. Ensure training is completed as identified in Section 506.3.3., "Training," by all applicable personnel before employees work on the project. Document and submit a list, signed by the CRPE, of all applicable Contractor and subcontractor employees who have completed the training. Include the employee's name, the training course name, and date the employee completed the training. Provide the most current list at the preconstruction conference or before SWP3 or soil disturbing activities. Update the list as needed and provide the updated list when updated.

3.2. **Contractor Superintendent Qualifications and Responsibilities**. Provide a superintendent that is competent, has experience with and knowledge of storm water management, and is knowledgeable of the requirements and the conditions of the TPDES General Permit TXR150000. The superintendent will manage and oversee the day to day operations and activities at the project site; work with the CRPE to provide effective storm water management at the project site; represent and act on behalf of the Contractor; and attend the Department's preconstruction conference for the project.

3.3. **Training**. All Contractor and subcontractor employees involved in soil disturbing activities, small or large structures, storm water control measures, and seeding activities must complete training as prescribed by the Department.

4. CONSTRUCTION

4.1. **Contractor Responsibilities**. Implement the SWP3 for the project site in accordance with the plans and specifications, TPDES General Permit TXR150000, and as directed. Coordinate storm water management with all other work on the project. Develop and implement an SWP3 for project-specific material supply plants within and outside of the Department's right of way in accordance with the specific or general storm water permit requirements. Prevent water pollution from storm water associated with construction activity from entering any surface water or private property on or adjacent to the project site.

4.2. **Implementation**. The CRPE, or alternate CRPE, must be accessible by phone and able to respond to project-related storm water management or other environmental emergencies 24 hr. per day.

4.2.1. **Commencement**. Implement the SWP3 as shown and as directed. Contractor-proposed recommendations for changes will be allowed as approved. Conform to the established guidelines in the TPDES General Permit TXR150000 to make changes. Do not implement changes until approval has been received and changes have been incorporated into the plans. Minor adjustments to meet field conditions are allowed and will be recorded in the SWP3.

4.2.2. **Phasing**. Implement control measures before the commencement of activities that result in soil disturbance. Phase and minimize the soil disturbance to the areas shown on the plans. Coordinate temporary control measures with permanent control measures and all other work activities on the project to assure economical, effective, safe, and continuous water pollution prevention. Provide control measures that are appropriate to the construction means, methods, and sequencing allowed by the Contract. Exercise precaution throughout the life of the project to prevent pollution of ground waters and surface waters. Schedule and perform clearing and grubbing operations so that stabilization measures will follow immediately thereafter if project conditions permit. Bring all grading sections to final grade as soon as possible and implement temporary and permanent control measures at the earliest time possible. Implement temporary control measures when required by the TPDES General Permit TXR150000 or otherwise necessitated by project conditions.

Do not prolong final grading and shaping. Preserve vegetation where possible throughout the project, and minimize clearing, grubbing, and excavation within stream banks, bed, and approach sections.

4.3. **General**.

4.3.1. **Temporary Alterations or Control Measure Removal**. Altering or removal of control measures is allowed when control measures are restored within the same working day.

4.3.2. **Stabilization**. Initiate stabilization for disturbed areas no more than 14 days after the construction activities in that portion of the site have temporarily or permanently ceased. Establish a uniform vegetative cover or use another stabilization practice in accordance with the TPDES General Permit TXR150000.

4.3.3. **Finished Work**. Remove and dispose of all temporary control measures upon acceptance of vegetative cover or other stabilization practice unless otherwise directed. Complete soil disturbing activities and establish a uniform perennial vegetative cover. A project will not be considered for acceptance until a vegetative cover of 70% density of existing adjacent undisturbed areas is obtained or equivalent permanent stabilization is obtained in accordance with the TPDES General Permit TXR150000. An exception will be allowed in arid areas as defined in the TPDES General Permit TXR150000.

4.3.4. **Restricted Activities and Required Precautions**. Do not discharge onto the ground or surface waters any pollutants such as chemicals, raw sewage, fuels, lubricants, coolants, hydraulic fluids, bitumens, or any other petroleum product. Operate and maintain equipment on-site to prevent actual or potential water pollution. Manage, control, and dispose of litter on-site such that no adverse impacts to water quality occur. Prevent dust from creating a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property. Wash out concrete trucks only as described in the TPDES General Permit TXR150000. Use appropriate controls to minimize the offsite transport of suspended sediments and other pollutants if it is necessary to pump or channel standing water (i.e., dewatering). Prevent discharges that would contribute to a violation of Edwards Aquifer Rules, water quality standards, the impairment of a listed water body, or other state or federal law.

4.4. **Installation, Maintenance, and Removal Work**. Perform work in accordance with the SWP3, according to manufacturers' guidelines, and in accordance with the TPDES General Permit TXR150000. Install and maintain the integrity of temporary erosion and sedimentation control devices to accumulate silt and debris until soil disturbing activities are completed and permanent erosion control features are in place or the disturbed area has been adequately stabilized as approved.

The Department will inspect and document the condition of the control measures at the frequency shown on the plans and will provide the Construction SWP3 Field Inspection and Maintenance Reports to the Contractor. Make corrections as soon as possible before the next anticipated rain event or within 7 calendar days after being able to enter the worksite for each control measure. The only acceptable reason for not accomplishing the corrections with the time frame specified is when site conditions are "Too Wet to Work." Take immediate action if a correction is deemed critical as directed. When corrections are not made within the established time frame, all work will cease on the project and time charges will continue while the control measures are brought into compliance. Commence work once the Engineer reviews and documents the project is in compliance. Commencing work does not release the Contractor of the liability for noncompliance of the SWP3, plans, or TPDES General Permit TXR150000.

The Engineer may limit the disturbed area if the Contractor cannot control soil erosion and sedimentation resulting from the Contractor's operations. Implement additional controls as directed.

Remove devices upon approval or as directed. Finish-grade and dress the area upon removal. Stabilize disturbed areas in accordance with the permit, and as shown on the plans or directed. Materials removed are considered consumed by the project. Retain ownership of stockpiled material and remove it from the project when new installations or replacements are no longer required.

4.4.1. **Rock Filter Dams for Erosion Control**. Remove trees, brush, stumps, and other objectionable material that may interfere with the construction of rock filter dams. Place sandbags as a foundation when required or at the Contractor's option.

Place the aggregate to the lines, height, and slopes specified, without undue voids for Types 1, 2, 3, and 5. Place the aggregate on the mesh and then fold the mesh at the upstream side over the aggregate and secure it to itself on the downstream side with wire ties, or hog rings for Types 2 and 3, or as directed. Place rock filter dams perpendicular to the flow of the stream or channel unless otherwise directed. Construct filter dams according to the following criteria unless otherwise shown on the plans:

4.4.1.1. **Type 1 (Non-Reinforced)**.

- **Height**. At least 18 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.2. **Type 2 (Reinforced)**.

- **Height**. At least 18 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.3. **Type 3 (Reinforced)**.

- **Height**. At least 36 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.4. **Type 4 (Sack Gabions)**. Unfold sack gabions and smooth out kinks and bends. Connect the sides by lacing in a single loop–double loop pattern on 4- to 5-in. spacing for vertical filling. Pull the end lacing rod at one end until tight, wrap around the end, and twist 4 times. Fill with stone at the filling end, pull the rod tight, cut the wire with approximately 6 in. remaining, and twist wires 4 times.

Place the sack flat in a filling trough, fill with stone, connect sides, and secure ends as described above for horizontal filling.

Lift and place without damaging the gabion. Shape sack gabions to existing contours.

4.4.1.5. **Type 5**. Provide rock filter dams as shown on the plans.

4.4.2. **Temporary Pipe Slope Drains**. Install pipe with a slope as shown on the plans or as directed. Construct embankment for the drainage system in 8-in. lifts to the required elevations. Hand-tamp the soil around and under the entrance section to the top of the embankment as shown on the plans or as directed. Form the top of the embankment or earth dike over the pipe slope drain at least 1 ft. higher than the top of the inlet pipe at all points. Secure the pipe with hold-downs or hold-down grommets spaced a maximum of 10 ft. on center. Construct the energy dissipaters or sediment traps as shown on the plans or as directed. Construct the sediment trap using concrete or rubble riprap in accordance with Item 432, "Riprap," when designated on the plans.

4.4.3. **Temporary Paved Flumes**. Construct paved flumes as shown on the plans or as directed. Provide excavation and embankment (including compaction of the subgrade) of material to the dimensions shown on the plans unless otherwise indicated. Install a rock or rubble riprap energy dissipater, constructed from the materials specified above, to a minimum depth of 9 in. at the flume outlet to the limits shown on the plans or as directed.

4.4.4. **Construction Exits**. Prevent traffic from crossing or exiting the construction site or moving directly onto a public roadway, alley, sidewalk, parking area, or other right of way areas other than at the location of construction exits when tracking conditions exist. Construct exits for either long- or short-term use.

4.4.4.1. **Long-Term**. Place the exit over a foundation course as required. Grade the foundation course or compacted subgrade to direct runoff from the construction exits to a sediment trap as shown on the plans or as directed. Construct exits with a width of at least 14 ft. for one-way and 20 ft. for two-way traffic for the full width of the exit, or as directed.

4.4.4.1.1. **Type 1**. Construct to a depth of at least 8 in. using crushed aggregate as shown on the plans or as directed.

4.4.4.1.2. **Type 2**. Construct using railroad ties and timbers as shown on the plans or as directed.

4.4.4.2. **Short-Term.**

4.4.4.2.1. **Type 3.** Construct using crushed aggregate, plywood, or wafer board. This type of exit may be used for daily operations where long-term exits are not practical.

4.4.4.2.2. **Type 4.** Construct as shown on the plans or as directed.

4.4.5. **Earthwork for Erosion Control.** Perform excavation and embankment operations to minimize erosion and to remove collected sediments from other erosion control devices.

4.4.5.1. **Excavation and Embankment for Erosion Control Features.** Place earth dikes, swales, or combinations of both along the low crown of daily lift placement, or as directed, to prevent runoff spillover. Place swales and dikes at other locations as shown on the plans or as directed to prevent runoff spillover or to divert runoff. Construct cuts with the low end blocked with undisturbed earth to prevent erosion of hillsides. Construct sediment traps at drainage structures in conjunction with other erosion control measures as shown on the plans or as directed.

Create a sediment basin, where required, providing 3,600 cu. ft. of storage per acre drained, or equivalent control measures for drainage locations that serve an area with 10 or more disturbed acres at one time, not including offsite areas.

4.4.5.2. **Excavation of Sediment and Debris.** Remove sediment and debris when accumulation affects the performance of the devices, after a rain, and when directed.

4.4.6. **Construction Perimeter Fence.** Construct, align, and locate fencing as shown on the plans or as directed.

4.4.6.1. **Installation of Posts.** Embed posts 18 in. deep or adequately anchor in rock, with a spacing of 8 to 10 ft.

4.4.6.2. **Wire Attachment.** Attach the top wire to the posts at least 3 ft. from the ground. Attach the lower wire midway between the ground and the top wire.

4.4.6.3. **Flag Attachment.** Attach flagging to both wire strands midway between each post. Use flagging at least 18 in. long. Tie flagging to the wire using a square knot.

4.4.7. **Sandbags for Erosion Control.** Construct a berm or dam of sandbags that will intercept sediment-laden storm water runoff from disturbed areas, create a retention pond, detain sediment, and release water in sheet flow. Fill each bag with sand so that at least the top 6 in. of the bag is unfilled to allow for proper tying of the open end. Place the sandbags with their tied ends in the same direction. Offset subsequent rows of sandbags 1/2 the length of the preceding row. Place a single layer of sandbags downstream as a secondary debris trap. Place additional sandbags as necessary or as directed for supplementary support to berms or dams of sandbags or earth.

4.4.8. **Temporary Sediment-Control Fence.** Provide temporary sediment-control fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the fence into erosion-control measures used to control sediment in areas of higher flow. Install the fence as shown on the plans, as specified in this Section, or as directed.

4.4.8.1. **Installation of Posts.** Embed posts at least 18 in. deep, or adequately anchor, if in rock, with a spacing of 6 to 8 ft. and install on a slight angle toward the runoff source.

4.4.8.2. **Fabric Anchoring.** Dig trenches along the uphill side of the fence to anchor 6 to 8 in. of fabric. Provide a minimum trench cross-section of 6 × 6 in. Place the fabric against the side of the trench and align approximately 2 in. of fabric along the bottom in the upstream direction. Backfill the trench, then hand-tamp.

4.4.8.3. **Fabric and Net Reinforcement Attachment.** Attach the reinforcement to wooden posts with staples, or to steel posts with T-clips, in at least 4 places equally spaced unless otherwise shown on the plans. Sewn

vertical pockets may be used to attach reinforcement to end posts. Fasten the fabric to the top strand of reinforcement by hog rings or cord every 15 in. or less.

4.4.8.4. **Fabric and Net Splices**. Locate splices at a fence post with a minimum lap of 6 in. attached in at least 6 places equally spaced unless otherwise shown on the plans. Do not locate splices in concentrated flow areas.

Requirements for installation of used temporary sediment-control fence include the following:

- fabric with minimal or no visible signs of biodegradation (weak fibers),
- fabric without excessive patching (more than 1 patch every 15 to 20 ft.),
- posts without bends, and
- backing without holes.

4.4.9. **Biodegradable Erosion Control Logs**. Install biodegradable erosion control logs near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the biodegradable erosion control logs into the erosion measures used to control sediment in areas of higher flow. Install, align, and locate the biodegradable erosion control logs as specified below, as shown on the plans, or as directed.

Secure biodegradable erosion control logs in a method adequate to prevent displacement as a result of normal rain events, prevent damage to the logs, and as approved, such that flow is not allowed under the logs. Temporarily removing and replacing biodegradable erosion logs as to facilitate daily work is allowed at the Contractor's expense.

4.4.10. **Vertical Tracking**. Perform vertical tracking on slopes to temporarily stabilize soil. Provide equipment with a track undercarriage capable of producing a linear soil impression measuring a minimum of 12 in. long × 2 to 4 in. wide × 1/2 to 2 in. deep. Do not exceed 12 in. between track impressions. Install continuous linear track impressions where the 12 in. length impressions are perpendicular to the slope. Vertical tracking is required on projects where soil disturbing activities have occurred unless otherwise approved.

4.5. **Monitoring and Documentation**. Monitor the control measures on a daily basis as long as there are BMPs in place and/or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES General Permit TXR150000. During time suspensions when work is not occurring or contract non-work days, daily inspections are not required unless a rain event has occurred. Monitoring will consist of, but is not limited to, observing, inspecting, and documenting site locations with control measures and discharge points to provide maintenance and inspection of controls as described in the SWP3. Keep written records of daily monitoring. Document in the daily monitoring report the control measure condition, the date of inspection, required corrective actions, responsible person for making the corrections, and the date corrective actions were completed. Maintain records of all monitoring reports at the project site or at an approved place. Provide copies within 7 days. Together, the CRPE and an Engineer's representative will complete the Construction Stage Gate Checklist on a periodic basis as directed.

5. MEASUREMENT

5.1. **Rock Filter Dams**. Installation or removal of rock filter dams will be measured by the foot or by the cubic yard. The measured volume will include sandbags, when used.

5.1.1. **Linear Measurement**. When rock filter dams are measured by the foot, measurement will be along the centerline of the top of the dam.

5.1.2. **Volume Measurement**. When rock filter dams are measured by the cubic yard, measurement will be based on the volume of rock computed by the method of average end areas.

5.1.2.1. **Installation**. Measurement will be made in final position.

5.1.2.2. **Removal**. Measurement will be made at the point of removal.

5.2. **Temporary Pipe Slope Drains**. Temporary pipe slope drains will be measured by the foot.

5.3. **Temporary Paved Flumes**. Temporary paved flumes will be measured by the square yard of surface area. The measured area will include the energy dissipater at the flume outlet.

5.4. **Construction Exits**. Construction exits will be measured by the square yard of surface area.

5.5. **Earthwork for Erosion and Sediment Control**.

5.5.1. **Equipment and Labor Measurement**. Equipment and labor used will be measured by the actual number of hours the equipment is operated and the labor is engaged in the work.

5.5.2. **Volume Measurement**.

5.5.2.1. **In Place**.

5.5.2.1.1. **Excavation**. Excavation will be measured by the cubic yard in its original position and the volume computed by the method of average end areas.

5.5.2.1.2. **Embankment**. Embankment will be measured by the cubic yard in its final position by the method of average end areas. The volume of embankment will be determined between:

- the original ground surfaces or the surface upon that the embankment is to be constructed for the feature and
- the lines, grades and slopes of the accepted embankment for the feature.

5.5.2.2. **In Vehicles**. Excavation and embankment quantities will be combined and paid for under "Earthwork (Erosion and Sediment Control, In Vehicle)." Excavation will be measured by the cubic yard in vehicles at the point of removal. Embankment will be measured by the cubic yard in vehicles measured at the point of delivery. Shrinkage or swelling factors will not be considered in determining the calculated quantities.

5.6. **Construction Perimeter Fence**. Construction perimeter fence will be measured by the foot.

5.7. **Sandbags for Erosion Control**. Sandbags will be measured as each sandbag or by the foot along the top of sandbag berms or dams.

5.8. **Temporary Sediment-Control Fence**. Installation or removal of temporary sediment-control fence will be measured by the foot.

5.9. **Biodegradable Erosion Control Logs**. Installation or removal of biodegradable erosion control logs will be measured by the foot along the centerline of the top of the control logs.

5.10. **Vertical Tracking**. Vertical tracking will not be measured or paid for directly but is considered subsidiary to this Item.

6. PAYMENT

The following will not be paid for directly but are subsidiary to pertinent Items:

- erosion-control measures for Contractor project-specific locations (PSLs) inside and outside the right of way (such as construction and haul roads, field offices, equipment and supply areas, plants, and material sources);
- removal of litter, unless a separate pay item is shown on the plans;
- repair to devices and features damaged by Contractor operations;
- added measures and maintenance needed due to negligence, carelessness, lack of maintenance, and failure to install permanent controls;

- removal and reinstallation of devices and features needed for the convenience of the Contractor;
- finish grading and dressing upon removal of the device; and
- minor adjustments including but not limited to plumbing posts, reattaching fabric, minor grading to maintain slopes on an erosion embankment feature, or moving small numbers of sandbags.

Stabilization of disturbed areas will be paid for under pertinent Items except vertical tacking which is subsidiary.

Furnishing and installing pipe for outfalls associated with sediment traps and ponds will not be paid for directly but is subsidiary to the excavation and embankment under this Item.

6.1. **Rock Filter Dams**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows:

6.1.1. **Installation**. Installation will be paid for as "Rock Filter Dams (Install)" of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.1.2. **Removal**. Removal will be paid for as "Rock Filter Dams (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

When the Engineer directs that the rock filter dam installation or portions thereof be replaced, payment will be made at the unit price bid for "Rock Filter Dams (Remove)" and for "Rock Filter Dams (Install)" of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.2. **Temporary Pipe Slope Drains**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Pipe Slope Drains" of the size specified. This price is full compensation for furnishing materials, removal and disposal, furnishing and operating equipment, labor, tools, and incidentals.

Removal of temporary pipe slope drains will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the pipe slope drain installation or portions thereof be replaced, payment will be made at the unit price bid for "Temporary Pipe Slope Drains" of the size specified, which is full compensation for the removal and reinstallation of the pipe drain.

Earthwork required for the pipe slope drain installation, including construction of the sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

Riprap concrete or stone, when used as an energy dissipater or as a stabilized sediment trap, will be measured and paid for in accordance with Item 432, "Riprap."

6.3. **Temporary Paved Flumes**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Paved Flume (Install)" or "Temporary Paved Flume (Remove)." This price is full compensation for furnishing and placing materials, removal and disposal, equipment, labor, tools, and incidentals.

When the Engineer directs that the paved flume installation or portions thereof be replaced, payment will be made at the unit prices bid for "Temporary Paved Flume (Remove)" and "Temporary Paved Flume (Install)." These prices are full compensation for the removal and replacement of the paved flume and for equipment, labor, tools, and incidentals.

Earthwork required for the paved flume installation, including construction of a sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

6.4. **Construction Exits**. Contractor-required construction exits from off right of way locations or on-right of way PSLs will not be paid for directly but are subsidiary to pertinent Items.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" for construction exits needed on right of way access to work areas required by the Department will be paid for at the unit price bid for "Construction Exits (Install)" of the type specified or "Construction Exits (Remove)." This price is full compensation for furnishing and placing materials, excavating, removal and disposal, cleaning vehicles, labor, tools, and incidentals.

When the Engineer directs that a construction exit or portion thereof be removed and replaced, payment will be made at the unit prices bid for "Construction Exit (Remove)" and "Construction Exit (Install)" of the type specified. These prices are full compensation for the removal and replacement of the construction exit and for equipment, labor, tools, and incidentals.

Construction of sediment traps used in conjunction with the construction exit will be measured and paid for under "Earthwork for Erosion and Sediment Control."

6.5. **Earthwork for Erosion and Sediment Control**.

6.5.1. **Initial Earthwork for Erosion and Sediment Control**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Erosion and Sediment Control, In Place)," "Embankment (Erosion and Sediment Control, In Place)," "Excavation (Erosion and Sediment Control, In Vehicle)," "Embankment (Erosion and Sediment Control, (In Vehicle)," or "Earthwork (Erosion and Sediment Control, In Vehicle)."

This price is full compensation for excavation and embankment including hauling, disposal of material not used elsewhere on the project; embankments including furnishing material from approved sources and construction of erosion-control features; and equipment, labor, tools, and incidentals.

Sprinkling and rolling required by this Item will not be paid for directly but will be subsidiary to this Item.

6.5.2. **Maintenance Earthwork for Erosion and Sediment Control for Cleaning and Restoring Control Measures**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid under a Contractor Force Account Item from invoice provided to the Engineer.

This price is full compensation for excavation, embankment, and re-grading including removal of accumulated sediment in various erosion control installations as directed, hauling, and disposal of material not used elsewhere on the project; excavation for construction of erosion-control features; embankments including furnishing material from approved sources and construction of erosion-control features; and equipment, labor, tools, and incidentals.

Earthwork needed to remove and obliterate erosion-control features will not be paid for directly but is subsidiary to pertinent Items unless otherwise shown on the plans.

Sprinkling and rolling required by this Item will not be paid for directly but will be subsidiary to this Item.

6.6. **Construction Perimeter Fence**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Construction Perimeter Fence." This price is full compensation for furnishing and placing the fence; digging, fence posts, wire, and flagging; removal and disposal; and materials, equipment, labor, tools, and incidentals.

Removal of construction perimeter fence will be not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the perimeter fence installation or portions thereof be removed and replaced, payment will be made at the unit price bid for "Construction Perimeter Fence," which is full compensation for the removal and reinstallation of the construction perimeter fence.

6.7. **Sandbags for Erosion Control.** Sandbags will be paid for at the unit price bid for "Sandbags for Erosion Control" (of the height specified when measurement is by the foot). This price is full compensation for materials, placing sandbags, removal and disposal, equipment, labor, tools, and incidentals.

Removal of sandbags will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the sandbag installation or portions thereof be replaced, payment will be made at the unit price bid for "Sandbags for Erosion Control," which is full compensation for the reinstallation of the sandbags.

6.8. **Temporary Sediment-Control Fence.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows:

6.8.1. **Installation.** Installation will be paid for as "Temporary Sediment-Control Fence (Install)." This price is full compensation for furnishing and operating equipment finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.8.2. **Removal.** Removal will be paid for as "Temporary Sediment-Control Fence (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

6.9. **Biodegradable Erosion Control Logs.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows:

6.9.1. **Installation.** Installation will be paid for as "Biodegradable Erosion Control Logs (Install)" of the size specified. This price is full compensation for furnishing and operating equipment finish backfill and grading, staking, proper disposal, labor, materials, tools, and incidentals.

6.9.2. **Removal.** Removal will be paid for as "Biodegradable Erosion Control Logs (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

6.10. **Vertical Tracking.** Vertical tracking will not be measured or paid for directly but is considered subsidiary to this Item.

In accordance with Texas Government Code §2161.252, a proposal that does not contain an up-to-date HUB Subcontracting Plan (HSP) is non-responsive and will be rejected without further evaluation. In addition, if the Department determines that the HSP was not developed in good faith, it will reject the proposal for failing to comply with material specifications based on the IFB.

Click + Control to follow the link below to get current HUB Subcontracting Plan documents.
https://comptroller.texas.gov/purchasing/docs/hub-forms/hsp-allfms.pdf

I.3.1 Introduction

The Department is committed to promoting full and equal business opportunities for businesses in state contracting in accordance with the goals specified in the State of Texas Disparity Study. The Department encourages the use of Historically Underutilized Businesses (HUBs) through race, ethnic and gender-neutral means.

Pursuant to Texas Government Code §2161.181 and §2161.182, and the Department's HUB policy and rules, the Department is required to make a good faith effort to increase HUB participation in its contracts. The Department may accomplish the goal of increased HUB participation by contracting directly with HUBs or indirectly through subcontracting opportunities.

I.3.2 Department's Administrative Rules

The Department has adopted the CPA's HUB rules as its own. The Department's HUB rules are located in Title 43, Part 1, Chapter 9, Subchapter L of the Texas Administrative Code, and the CPA rules are located in Title 34, Part 1, Chapter 20, Subchapter D, Division 1. If there are any discrepancies between the Department's administrative rules and this **IFB**, the rules shall take priority.

I.3.3 HUB Participation Goal

The CPA has established statewide HUB participation goals for different categories of contracts in 34 T.A.C. §20.284. In order to meet or exceed the HUB participation goals, the Department encourages outreach to certified HUBs. Contractors shall make a good faith effort to include certified HUBs in the procurement process.

This contract is classified as a **Building Construction** contract under the CPA rule, and therefore has a HUB Annual Procurement Utilization Goal of **21.1%** per fiscal year.

I.3.4 Required HUB Subcontracting Plan

In accordance with Government Code, Chapter 2161, Subchapter F, each state agency that considers entering into a contract with an expected value of $100,000 or more over the life of the contract (including any renewals) shall, before the agency solicits bids, proposals, offers, or other applicable expressions of interest, determine whether subcontracting opportunities are probable under the contract.

In accordance with 34 T.A.C. §20.285(a),(1),(C) of the HUB Rules. State agencies may determine that subcontracting is probable for only a subset of the work expected to be performed or the funds to be expended under the contract. If an agency determines that subcontracting is probable on only a portion of a contract, it shall document its reasons in writing for the procurement file.

The Department has determined that subcontracting opportunities are probable for this **IFB**. As a result, the respondent must submit an HSP with its proposal. The HSP is required whether a respondent intends to subcontract or not.

In the HSP, a respondent must indicate whether it is a Texas certified HUB. Being a certified HUB does not exempt a respondent from completing the HSP requirement.

The Department shall review the documentation submitted by the respondent to determine if a good faith effort has been made, in accordance with solicitation and HSP requirements. During the good faith effort evaluation, The Department may, at its discretion, allow clarifications or enhancements to information submitted with the HSP.

If the Department determines that the respondent's HSP was not developed in good faith, the HSP will be considered non-responsive and will be rejected as a material failure to comply with the advertised specifications. The reasons for rejection shall be recorded in the procurement file.

I.3.5 CPA Centralized Master Bidder's List

Respondents may search for HUB subcontractors in the CPA's Centralized Master Bidders List (CMBL)/HUB Directory. For this procurement, the Department has identified the following class and item codes for potential subcontracting opportunities:

NIGP Class/Item Code:
909-00 BUILDING CONSTRUCTION SERVICES, NEW, including Maintenance & Repair Services

Respondents are not required to use, nor limited to using, the class and item codes identified above, and may identify other areas for subcontracting.

The Department does not endorse, recommend nor attest to the capabilities of any company or individual listed on the CPA's CMBL. The list of certified HUBs is subject to change, so respondents are encouraged to refer to the CMBL often to find the most current listing of HUBs.

I.3.6 HUB Subcontracting Procedures – If a Respondent Intends to Subcontract

An HSP must demonstrate that the respondent made a good faith effort to comply with the Department's HUB policies and procedures. The following subparts outline the items that the Department will review in determining whether an HSP meets the good faith effort standard. A respondent that intends to subcontract must complete the HSP to document its good faith efforts.

I.3.6.1 Identify Subcontracting Areas and Divide Them into Reasonable Lots

A respondent should first identify each area of the contract work it intends to subcontract. Then, to maximize HUB participation, it should divide the contract work into reasonable lots or portions, to the extent consistent with prudent industry practices.

I.3.6.2 Notify Potential HUB Subcontractors

The HSP must demonstrate that the respondent made a good faith effort to subcontract with HUBs that have an active HUB certification. The respondent's good faith efforts shall be shown through utilization of all methods in conformance with the development and submission of the HSP and by complying with the following steps:

I.3.6.2.1 Divide the contract work into reasonable lots or portions to the extent consistent with prudent industry practices. The respondent must determine which portions of work, including goods and services, will be subcontracted.

I.3.6.2.2 Use the appropriate method(s) to demonstrate good faith effort. The respondent can use either method(s) 1, 2, or 3:

I.3.6.3 Method 1: Respondent Intends to Subcontract with only HUBs:

The respondent must identify in the HSP the HUBs, with an active HUB certification, that will be utilized and submit written documentation that confirms **100%** of all available subcontracting opportunities will be performed by one or more HUBs;

I.3.6.4 Method 2: Respondent Intends to Subcontract with HUBs and Non-HUBs (Meet or Exceed the Goal):

The respondent must identify in the HSP and submit written documentation that one or more HUBs, with an active HUB certification, will be utilized; and that the aggregate expected percentage of subcontracts with HUBs will meet or exceed the goal specified in this solicitation. Only HUB subcontractors that have an existing contract with the respondent for less than five years may be used to comply with the good faith effort requirements under this method.

When the aggregate expected percentage of subcontracts with HUBs meets or exceeds the goal specified in this solicitation, respondents may also use non-HUB subcontractors; **or,**

I.3.6.6 Method 3: Respondent Intends to Subcontract with HUBs and Non-HUBs (Does Not Meet or Exceed the Goal):

The respondent must identify in the HSP and submit documentation regarding both of the following requirements:

- Written notification to minority or women trade organizations or development centers to assist in identifying potential HUBs, with an active HUB certification, of the subcontracting opportunities the respondent intends to subcontract.

  Respondents must give minority or women trade organizations or development centers at least seven (7) working days prior to submission of the respondent's response for dissemination of the subcontracting opportunities to their members. A list of minority and women trade organizations is located on the CPA's website under the Minority and Women Organization link.

- Written notification to at least three (3) HUB businesses, with an active HUB certification, of the subcontracting opportunities that the respondent intends to subcontract. The written notice must be sent to potential HUB subcontractors prior to submitting proposals and must include:

  - a description of the scope of work to be subcontracted,
  - information regarding the location to review project plans or specifications,
  - information about bonding and insurance requirements,
  - required qualifications and other contract requirements, and
  - a description of how the subcontractor can contact the respondent.

  Respondents must give potential HUB subcontractors a reasonable amount of time to respond to the notice, at least seven (7) working days prior to submission of the respondent's response unless circumstances require a different time period, which is determined by the agency and documented in the contract file;

  Respondents must also use the CMBL, the HUB Directory, and Internet resources when searching for HUB subcontractors. Respondents may rely on the services of contractor groups; local, state and federal business assistance offices; and other organizations that provide assistance in identifying qualified applicants for the HUB program.

I.3.6.7 Written Justification of the Selection Process

The Department will make a determination if a good faith effort was made by the respondent in the development of the required HSP. One or more of the methods identified in the previous sections may be applicable to the respondent's good faith efforts in developing and submission of the HSP. The Department may require the respondent to submit additional documentation explaining how the respondent made a good faith effort in accordance with the solicitation.

A respondent must provide written justification of its selection process if it chooses a non-HUB subcontractor. The justification should demonstrate that the respondent negotiated in good faith with qualified HUB bidders, and did not reject qualified HUBs, with an active HUB certification, who were the best value responsive bidders.

I.3.7 Method 4: Respondent Does Not Intend to Subcontract

When the respondent plans to complete all contract requirements with its own equipment, supplies, materials and/or employees, it is still required to complete an HSP.

The respondent must complete the "Self Performance Justification" portion of the HSP, and attest that it does not intend to subcontract for any goods or services, including the class and item codes identified in Section I.3.5. In addition, the respondent must identify the sections of the proposal that describe how it will complete the Scope of Work using its own resources or provide a statement explaining how it will complete the Scope of Work using its own resources. The respondent must agree to comply with the following if requested by the Department:

- Provide evidence of sufficient respondent staffing to meet the **IFB** requirements,
- Provide monthly payroll records showing the respondent staff fully dedicated to the contract,
- Allow the Department to conduct an onsite review of company headquarters or work site where services are to be performed, and,
- Provide documentation proving employment of qualified personnel holding the necessary licenses and certificates required to perform the Scope of Work.

I.3.8 Post-award HSP Requirements

The HUB Subcontracting Plan (HSP) shall be reviewed and evaluated prior to contract award and, if accepted, the finalized HSP will become part of the contract with the successful respondent(s).

After contract award, the Department will coordinate a post-award meeting with the successful respondent to discuss HSP reporting requirements. The contractor must maintain business records documenting compliance with the HSP, and must submit monthly subcontract reports to the Department by completing the HUB "Prime Contractor Progress Assessment Report" and "**HUB Subcontracting Plan (HSP) Progress Compliance Form - 2579"**. This monthly report is required as a condition for payment to report to the agency the identity and the amount paid to all subcontractors.

As a condition of award the Contractor is required to send notification to all selected subcontractors as identified in the accepted/approved HSP. In addition, a copy of the notification must be provided to the agency's Contract Manager and/or HUB Program Office within 10 days of the contract award.

During the term of the contract, if the parties in the contract amend the contract to include a change to the scope of work or add additional funding, the Department will evaluate to determine the probability of additional subcontracting opportunities. When applicable, the Contractor must submit an HSP change request for the Department's review. The requirements for an HSP change request will be covered in the post-award meeting.

When making a change to an HSP, the Contractor will obtain prior written approval from the Department before making any changes to the HSP. Proposed changes must comply with the HUB Program good faith effort requirements relating to the development and submission of a HSP.

If the contractor decides to subcontract any part of the contract after the award, it must follow the good faith effort procedures outlined in Section I.3.6 of this **IFB** (e.g., divide work into reasonable lots, notify at least three (3) vendors per subcontracted area, provide written justification of the selection process, or participate in the Mentor Protégé Program).

For this reason, the Department encourages respondents to identify, as part of their HSP, multiple subcontractors who are able to perform the work in each area the respondent plans to subcontract. Selecting additional subcontractors may help the selected contractor make changes to its original HSP, when needed, and will allow the Department to approve any necessary changes expeditiously.

Failure to meet the HSP and post-award requirements will constitute a breach of contract, and will be subject to remedial actions. The Department may also report noncompliance to the CPA in accordance with the provisions of the Vendor Performance and Debarment Program (see 34 T.A.C. §20.585 relating to Debarment) and (see 34 T.A.C. §20.586 relating to Procedures for Investigations and Debarment).

"General Decision Number: TX20210025 01/01/2021

Superseded General Decision Number: TX20200025

State: Texas

Construction Type: Highway

Counties: Archer, Callahan, Clay, Collin, Dallas, Delta, Denton, Ellis, Grayson, Hunt, Johnson, Jones, Kaufman, Parker, Rockwall, Tarrant and Wise Counties in Texas.

HIGHWAY CONSTRUCTION PROJECTS (excluding tunnels, building structures in rest area projects & railroad construction; bascule, suspension & spandrel arch bridges designed for commercial navigation, bridges involving marine construction; and other major bridges).

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 www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/01/2021

* SUTX2011-007 08/03/2011

	Rates	Fringes
CONCRETE FINISHER (Paving and Structures)	$ 14.12	
ELECTRICIAN	$ 19.80	

FORM BUILDER/FORM SETTER
Paving & Curb.....$ 13.16
Structures.....$ 13.84

LABORER
Asphalt Raker.....$ 12.69
Flagger.....$ 10.06
Laborer, Common.....$ 10.72
Laborer, Utility.....$ 12.32
Pipelayer.....$ 13.24
Work Zone Barricade
Servicer.....$ 11.68

POWER EQUIPMENT OPERATOR:
Asphalt Distributor.....$ 15.32
Asphalt Paving Machine.....$ 13.99
Broom or Sweeper.....$ 11.74
Concrete Pavement
Finishing Machine.....$ 16.05
Concrete Saw.....$ 14.48
Crane Operator, Lattice
Boom 80 Tons or Less.....$ 17.27
Crane Operator, Lattice
Boom over 80 Tons.....$ 20.52
Crane, Hydraulic 80 Tons
or Less.....$ 18.12
Crawler Tractor.....$ 14.07
Excavator, 50,000 pounds
or less.....$ 17.19
Excavator, over 50,000
pounds.....$ 16.99
Foundation Drill , Truck
Mounted.....$ 21.07
Foundation Drill, Crawler
Mounted.....$ 17.99
Front End Loader 3 CY or
Less.....$ 13.69
Front End Loader, over 3 CY.$ 14.72
Loader/Backhoe.....$ 15.18
Mechanic.....$ 17.68
Milling Machine.....$ 14.32
Motor Grader, Fine Grade....$ 17.19
Motor Grader, Rough.....$ 16.02
Pavement Marking Machine....$ 13.63
Reclaimer/Pulverizer.....$ 11.01
Roller, Asphalt.....$ 13.08
Roller, Other.....$ 11.51
Scraper.....$ 12.96
Small Slipform Machine.....$ 15.96
Spreader Box.....$ 14.73

Servicer.....$ 14.58

Steel Worker (Reinforcing).....$ 16.18

TRUCK DRIVER
Lowboy-Float.....$ 16.24
Off Road Hauler.....$ 12.25
Single Axle.....$ 12.31
Single or Tandem Axle Dump
Truck.....$ 12.62
Tandem Axle Tractor with
Semi Trailer.....$ 12.86
Transit-Mix.....$ 14.14

WELDER.....$ 14.84

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 www.dol.gov/whd/govcontracts.

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.

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END OF GENERAL DECISION
"

"General Decision Number: TX20210239 03/12/2021

Superseded General Decision Number: TX20200239

State: Texas

Construction Type: Building

County: Collin 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 www.dol.gov/whd/govcontracts.

Modification Number	Publication Date
0	01/01/2021
1	03/12/2021

* ASBE0021-011 08/01/2017

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR (Duct, Pipe and Mechanical System Insulation)	$ 25.87	7.23

BOIL0074-003 01/01/2017

	Rates	Fringes
BOILERMAKER	$ 28.00	22.35

CARP1421-002 04/01/2016

	Rates	Fringes
MILLWRIGHT	$ 26.60	8.65

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* ELEV0021-006 01/01/2021

	Rates	Fringes
ELEVATOR MECHANIC	$ 44.02	36.365

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

ENGI0178-005 06/01/2020

	Rates	Fringes
POWER EQUIPMENT OPERATOR		
(1) Tower Crane	$ 32.85	13.10
(2) Cranes with Pile Driving or Caisson Attachment and Hydraulic Crane 60 tons and above	$ 28.75	10.60
(3) Hydraulic cranes 59 Tons and under	$ 32.35	13.10

IRON0263-005 06/01/2017

	Rates	Fringes
IRONWORKER (ORNAMENTAL AND STRUCTURAL)	$ 23.25	7.32

PLUM0100-005 11/01/2017

	Rates	Fringes
HVAC MECHANIC (HVAC Unit Installation Only)	$ 30.84	11.51
PIPEFITTER (Excludes HVAC Pipe Installation)	$ 30.84	11.51

SUTX2014-015 07/21/2014

	Rates	Fringes
BRICKLAYER	$ 21.06	0.00
CARPENTER, Excludes Drywall Hanging, Form Work, and Metal Stud Installation	$ 15.78	0.00
CAULKER	$ 15.16	0.00
CEMENT MASON/CONCRETE FINISHER	$ 13.04	0.00
DRYWALL HANGER AND METAL STUD INSTALLER	$ 13.00	0.00
ELECTRICIAN (Alarm Installation Only)	$ 20.93	3.86
ELECTRICIAN (Communication		

Technician Only)	$ 15.35	1.39
ELECTRICIAN (Low Voltage Wiring Only)	$ 17.04	1.39
ELECTRICIAN, Excludes Low Voltage Wiring and Installation of Alarms/Sound and Communication Systems	$ 20.01	2.69
FORM WORKER	$ 11.89	0.00
GLAZIER	$ 16.46	3.94
HIGHWAY/PARKING LOT STRIPING: Operator (Striping Machine)	$ 10.04	2.31
INSTALLER - SIDING (METAL/ALUMINUM/VINYL)	$ 14.74	0.00
INSTALLER - SIGN	$ 15.50	0.00
INSULATOR - BATT	$ 13.00	0.00
IRONWORKER, REINFORCING	$ 12.29	0.00
LABORER: Common or General	$ 10.52	0.00
LABORER: Mason Tender - Brick	$ 10.54	0.00
LABORER: Mason Tender - Cement/Concrete	$ 10.93	0.00
LABORER: Pipelayer	$ 13.00	0.35
LABORER: Plaster Tender	$ 12.22	0.00
LABORER: Roof Tearoff	$ 11.28	0.00
LABORER: Landscape and Irrigation	$ 10.55	0.00
LATHER	$ 16.00	0.00
OPERATOR: Backhoe/Excavator/Trackhoe	$ 12.83	0.00
OPERATOR: Bobcat/Skid Steer/Skid Loader	$ 13.93	0.00
OPERATOR: Bulldozer	$ 18.29	1.31
OPERATOR: Drill	$ 15.69	0.50
OPERATOR: Forklift	$ 13.21	0.81
OPERATOR: Grader/Blade	$ 13.03	0.00
OPERATOR: Loader	$ 13.46	0.85
OPERATOR: Mechanic	$ 17.52	3.33
OPERATOR: Paver (Asphalt, Aggregate, and Concrete)	$ 18.44	0.00

OPERATOR: Roller.....$ 15.04 0.00

PAINTER (Brush, Roller and
Spray), Excludes Drywall
Finishing/Taping.....$ 13.35 5.10

PAINTER: Drywall
Finishing/Taping Only.....$ 14.24 3.83

PIPEFITTER (HVAC Pipe
Installation Only).....$ 20.45 4.00

PLASTERER.....$ 16.58 0.00

PLUMBER, Excludes HVAC Pipe
Installation.....$ 22.46 4.06

ROOFER.....$ 17.19 0.00

SHEET METAL WORKER (HVAC Duct
Installation Only).....$ 21.13 4.79

SHEET METAL WORKER, Excludes
HVAC Duct Installation.....$ 24.88 5.97

SPRINKLER FITTER (Fire
Sprinklers).....$ 37.50 0.00

TILE FINISHER.....$ 11.22 0.00

TILE SETTER.....$ 14.25 0.00

TRUCK DRIVER: 1/Single Axle
Truck.....$ 16.00 0.81

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

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 www.dol.gov/whd/govcontracts.

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).

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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

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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.

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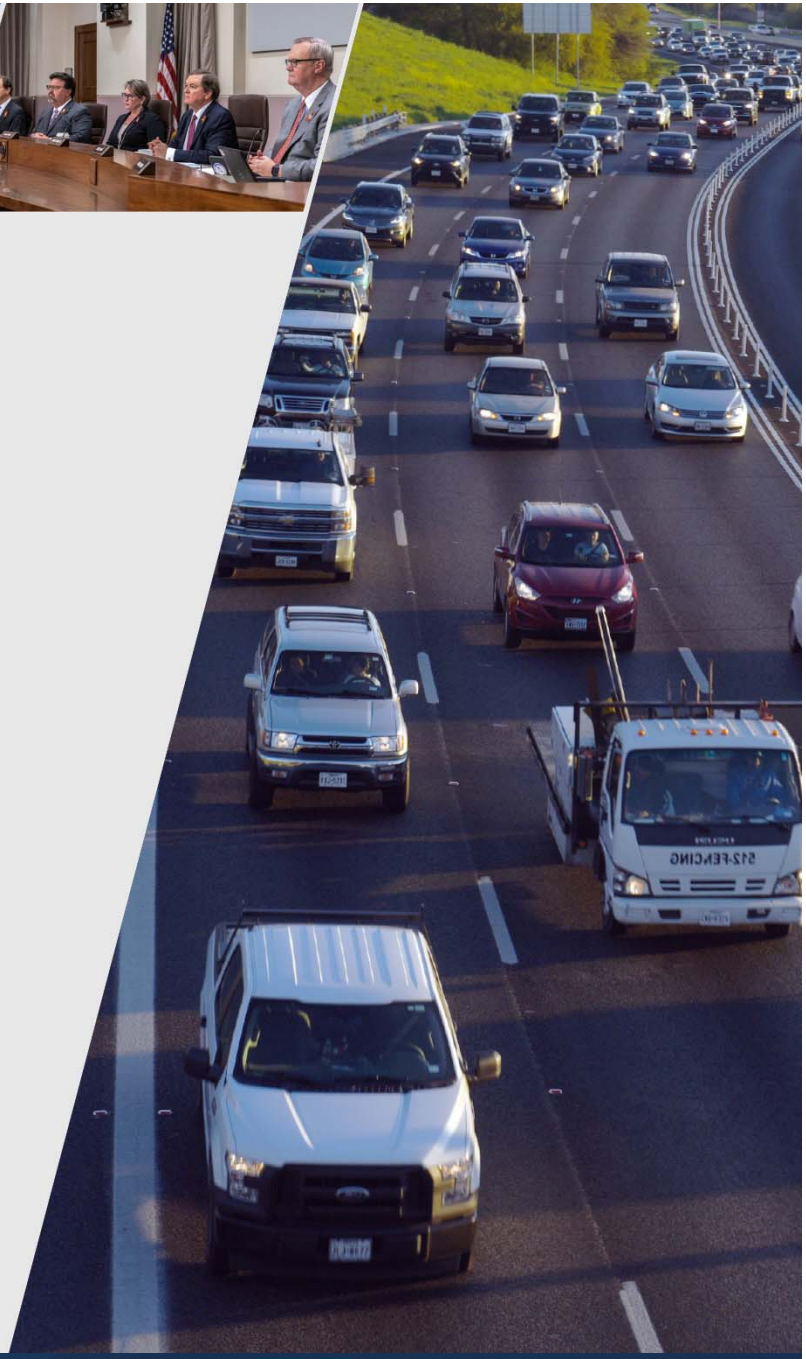
END OF GENERAL DECISION"

Historically Underutilized Business (HUB) Subcontracting Plan (HSP) Completion

TxDOT HUB Program



Revised August 2020

HUB Subcontracting Plan (HSP)

Make sure to use the most current HSP!!

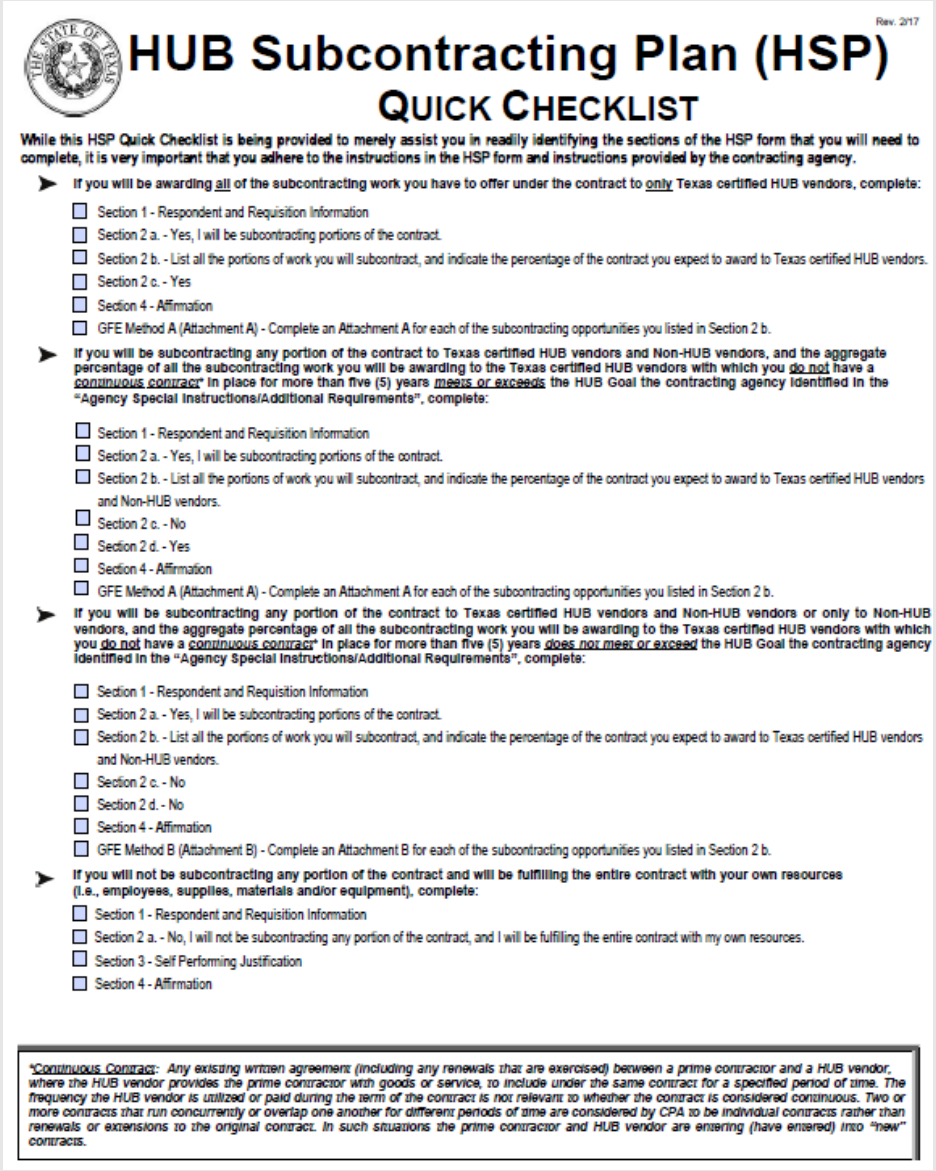
For the most current version, go to:

https://comptroller.texas.gov/purchasing/vendor/hub/forms.php

HUB Subcontracting Plan (HSP) Quick Checklist

This document was created by the Texas Comptroller of Public Accounts as a guide to complete the HSP.

There are 4 OPTIONS available to complete the HSP.



Rev. 2/17

HUB Subcontracting Plan (HSP)
QUICK CHECKLIST

While this HSP Quick Checklist is being provided to merely assist you in readily identifying the sections of the HSP form that you will need to complete, it is very important that you adhere to the instructions in the HSP form and instructions provided by the contracting agency.

➤ **If you will be awarding all of the subcontracting work you have to offer under the contract to only Texas certified HUB vendors, complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors.
- ☐ Section 2 c. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you do not have a *continuous contract** in place for more than five (5) years *meets or exceeds* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - Yes
- ☐ Section 4 - Affirmation
- ☐ GFE Method A (Attachment A) - Complete an Attachment A for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will be subcontracting any portion of the contract to Texas certified HUB vendors and Non-HUB vendors or only to Non-HUB vendors, and the aggregate percentage of all the subcontracting work you will be awarding to the Texas certified HUB vendors with which you do not have a *continuous contract** in place for more than five (5) years *does not meet or exceed* the HUB Goal the contracting agency identified in the "Agency Special Instructions/Additional Requirements", complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - Yes, I will be subcontracting portions of the contract.
- ☐ Section 2 b. - List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to Texas certified HUB vendors and Non-HUB vendors.
- ☐ Section 2 c. - No
- ☐ Section 2 d. - No
- ☐ Section 4 - Affirmation
- ☐ GFE Method B (Attachment B) - Complete an Attachment B for each of the subcontracting opportunities you listed in Section 2 b.

➤ **If you will not be subcontracting any portion of the contract and will be fulfilling the entire contract with your own resources (i.e., employees, supplies, materials and/or equipment), complete:**

- ☐ Section 1 - Respondent and Requisition Information
- ☐ Section 2 a. - No, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources.
- ☐ Section 3 - Self Performing Justification
- ☐ Section 4 - Affirmation

*Continuous Contract: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service, to include under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.

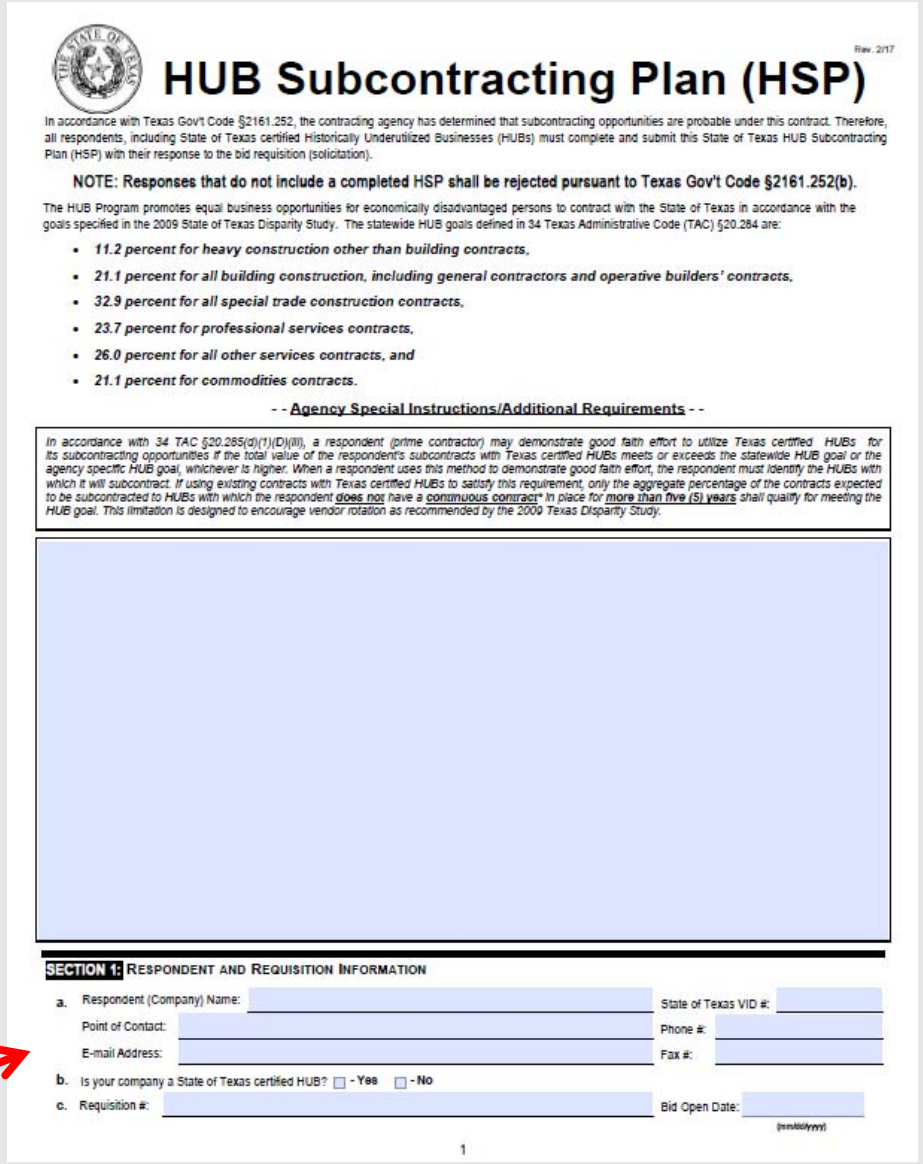
HSP Completion: Option 1 – Using Only HUBs

If all (100%) of your subcontracting opportunities will be performed using only HUB vendors, complete the following:

- Section 1 – Respondent and Requisition Information (Page 1);
- Section 2a – Yes, I will be subcontracting portions of the contract (Page 2);
- Section 2b – List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to HUB vendors (Page 2 and the continuation sheet as needed);
- Section 2c – Yes, I will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities listed (Page 2);
- Section 4 – Affirmation that all information and supporting documentation submitted is true and correct (Page 3); and
- HSP GFE Method A (Attachment A) – Complete this attachment for each subcontracting opportunity listed in Section 2b (Page 1 of 1).

HSP Completion: Option 1 – Using Only HUBs

Page 1



Rev. 2/17

HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.284 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.285(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

SECTION 1: RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: _____ State of Texas VID #: _____

Point of Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

b. Is your company a State of Texas certified HUB? ☐ - Yes ☐ - No

c. Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

1

Section 1: Respondent and Requisition Information

Complete all information requested.

HSP Completion: Option 1 – Using Only HUBs

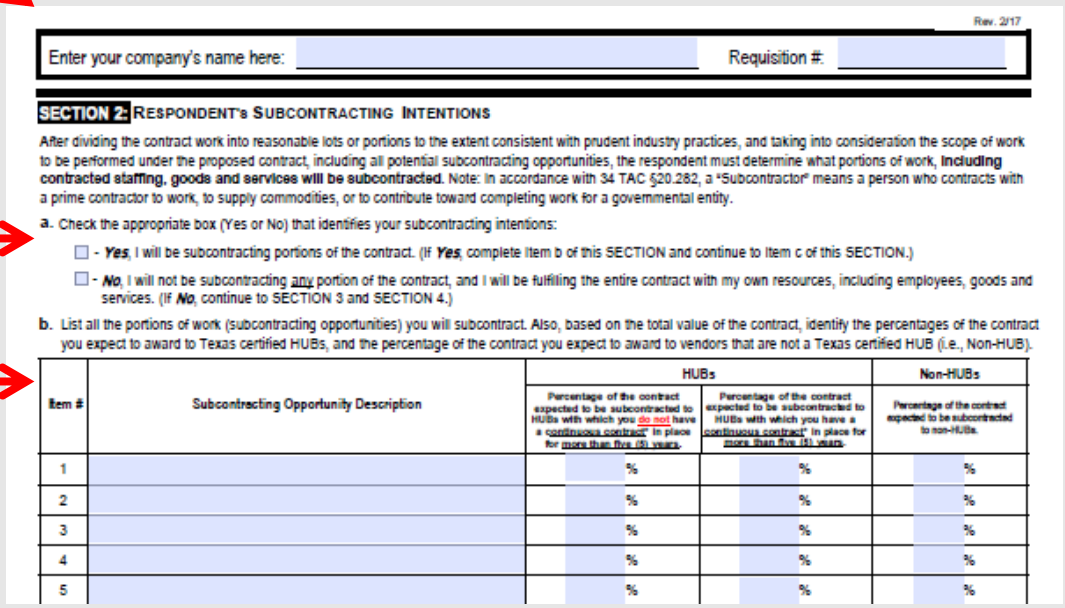
Page 2

Enter your Company's name and the requisition #. *(Enter this information on each subsequent page.)*

Section 2: Respondents Subcontracting Intentions

2a: ✓ Yes, I will be subcontracting portions of the contract.

2b: List all the portions of work you will be subcontracting to HUBs and the % of the contract you expect to award. (Aggregate percentage should not total 100%)



Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION 2: RESPONDENT'S SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods and services will be subcontracted.** Note: In accordance with 34 TAC §20.282, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☐ - ***Yes***, I will be subcontracting portions of the contract. (If ***Yes***, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - ***No***, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods and services. (If ***No***, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

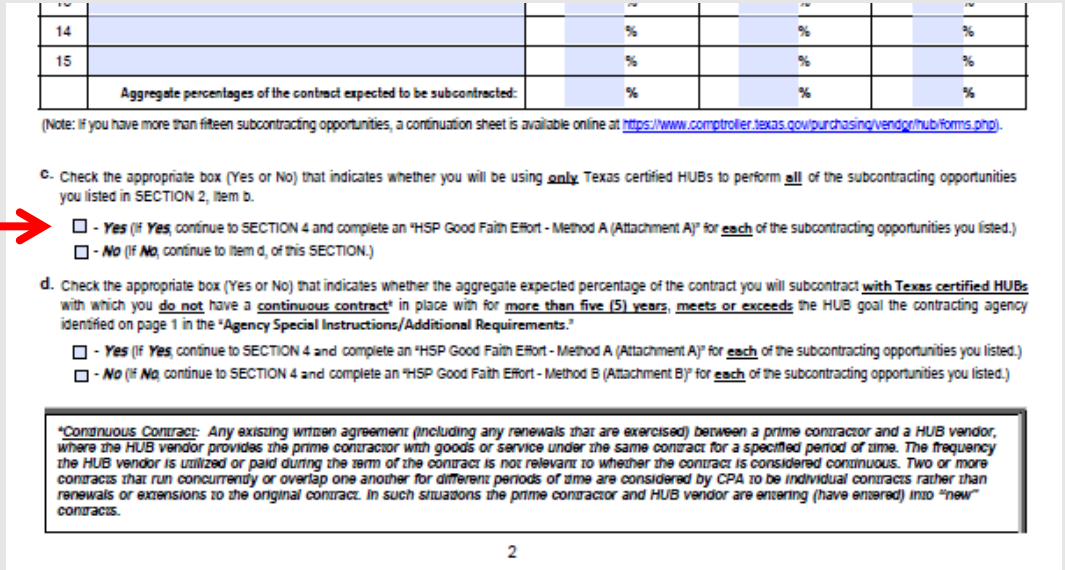
Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a "continuous contract" in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to HUBs with which you have a "continuous contract" in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to non-HUBs.
1		%	%	%
2		%	%	%
3		%	%	%
4		%	%	%
5		%	%	%

HSP Completion: Option 1 – Using Only HUBs

Page 2 (cont.)

Section 2: Respondents Subcontracting Intentions

2c: ✓ Yes, if you will only be using HUBs to perform ALL subcontracting opportunities in 2a.



14		%	%	%
15		%	%	%
	Aggregate percentages of the contract expected to be subcontracted:	%	%	%

(Note: If you have more than fifteen subcontracting opportunities, a continuation sheet is available online at https://www.comptroller.texas.gov/purchasing/vendor/hub/forms.php).

c. Check the appropriate box (Yes or No) that indicates whether you will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities you listed in SECTION 2, item b.

☐ - ***Yes*** (If ***Yes***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)
☐ - ***No*** (If ***No***, continue to item d, of this SECTION.)

d. Check the appropriate box (Yes or No) that indicates whether the aggregate expected percentage of the contract you will subcontract **with Texas certified HUBs** with which you **do not** have a **continuous contract*** in place with for **more than five (5) years**, **meets or exceeds** the HUB goal the contracting agency identified on page 1 in the "**Agency Special Instructions/Additional Requirements.**"

☐ - ***Yes*** (If ***Yes***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)
☐ - ***No*** (If ***No***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed.)

*Continuous Contract: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.

2

Move on to page 3, Section 4.

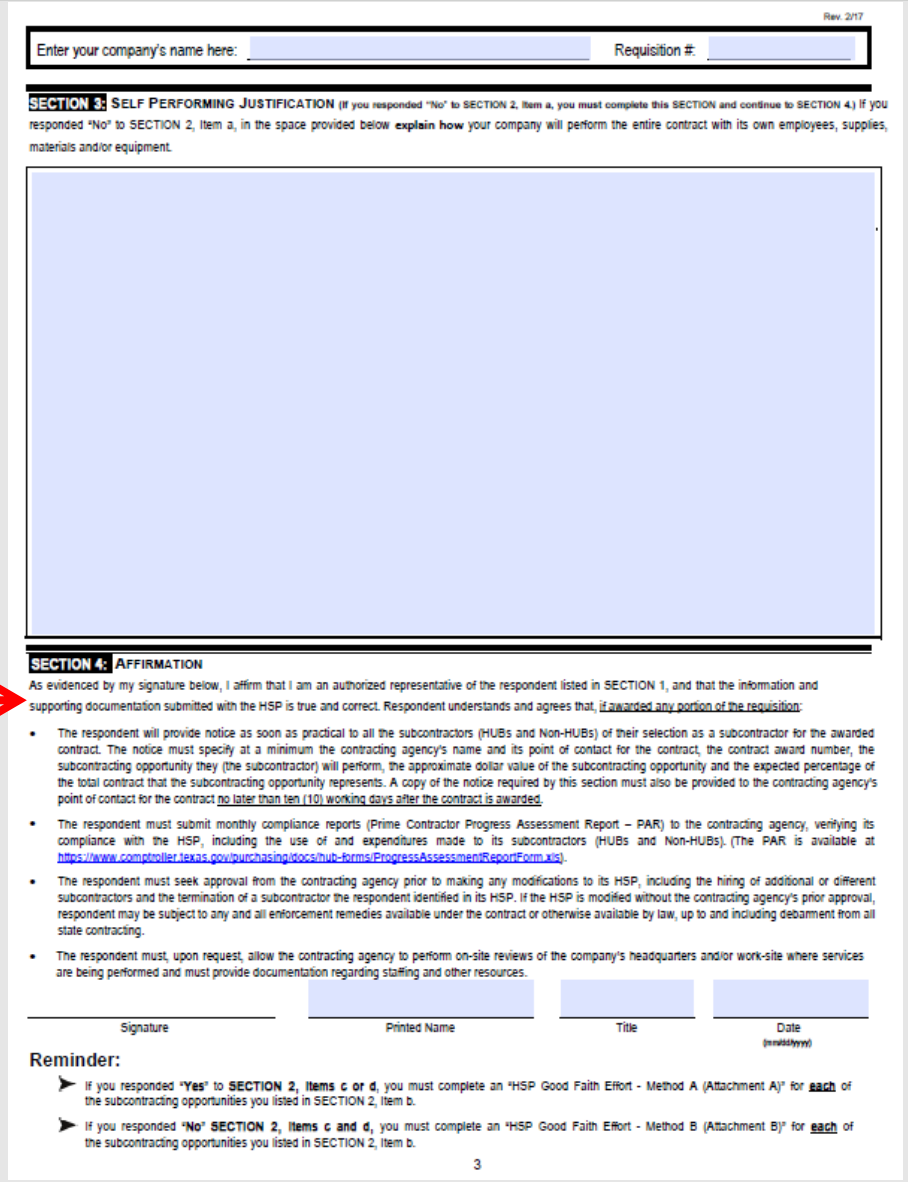
HSP Completion: Option 1 – Using Only HUBs

Page 3

Section 4: Affirmation

Read, sign and date to affirm the information you provided is true and correct.

Move on to "HSP Good Faith Effort – Method A (Attachment A)"



Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION 3: SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.) If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment.

SECTION 4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/ProgressAssessmentReportForm.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

Signature | Printed Name | Title | Date (mm/dd/yyyy)

Reminder:

- If you responded **"Yes"** to **SECTION 2, Items c or d**, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded **"No" SECTION 2, Items c and d**, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in SECTION 2, Item b.

3

HSP Completion: Option 1 – Using Only HUBs

HSP Good Faith Effort – Method A (Attachment A)

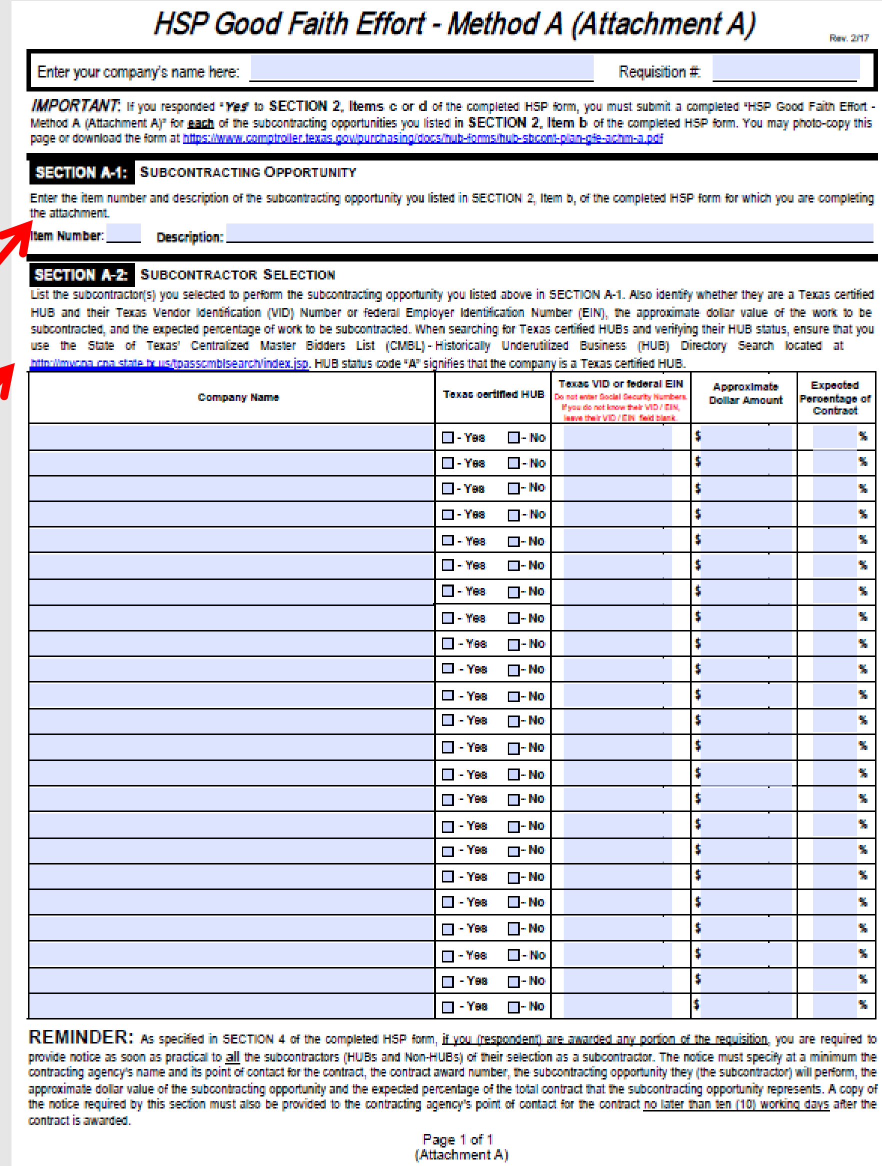
Section A-1:

List the information requested from the subcontracting opportunity.

Section A-2:

Provide all information requested.

Don't put 'To Be Determined (TBD)' under company name.



HSP Good Faith Effort - Method A (Attachment A)

Rev. 2/17

Enter your company's name here: ______ Requisition #: ______

IMPORTANT: If you responded "***Yes***" to **SECTION 2, Items c or d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/hub-sbcont-plan-gfe-achm-a.pdf

SECTION A-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: ______ **Description:** ______

SECTION A-2: SUBCONTRACTOR SELECTION

List the subcontractor(s) you selected to perform the subcontracting opportunity you listed above in SECTION A-1. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "A" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN (Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.)	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

Page 1 of 1
(Attachment A)

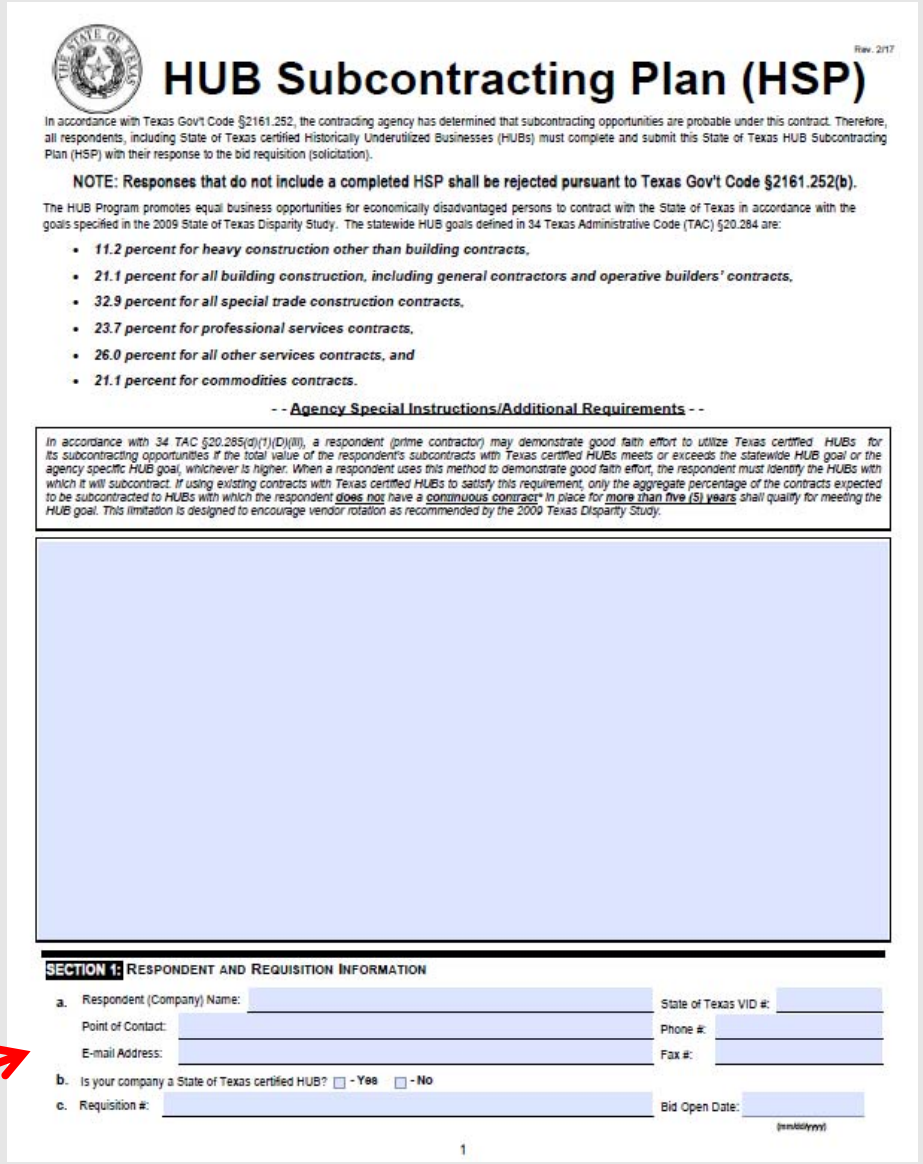
HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

If you are subcontracting with HUBs and Non-HUBs, and you meet or exceed the aggregate percentage (HUB Goal) of subcontracting with HUBs in which you do not have a continuous contract in place for more than five (5) years, complete the following :

- Section 1 – Respondent and Requisition Information (Page 1);
- Section 2a – Yes, I will be subcontracting portions of the contract (Page 2);
- Section 2b – List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to HUB vendors (Page 2 and the continuation sheet as needed);
- Section 2c – No, I will not be using only Texas certified HUBs to perform all of the subcontracting opportunities listed (Page 2);
- Section 2d – Yes, the aggregate expected percentage of the contract you will subcontract with Texas certified HUBs, which you do NOT have a continuous contract in place for five (5) years or more, meets or exceeds the HUB goal in the solicitation (Page 2);
- Section 4 – Affirmation that all information and supporting documentation submitted is true and correct (Page 3); and
- HSP GFE Method A (Attachment A) – Complete this attachment for each subcontracting opportunity listed in Section 2b (Page 1 of 1).

HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

Page 1



Rev. 2/17

HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.284 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.285(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

SECTION 1: RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: _____ State of Texas VID #: _____

Point of Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

b. Is your company a State of Texas certified HUB? ☐ - Yes ☐ - No

c. Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

1

Section 1: Respondent and Requisition Information

Complete all information requested.

HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

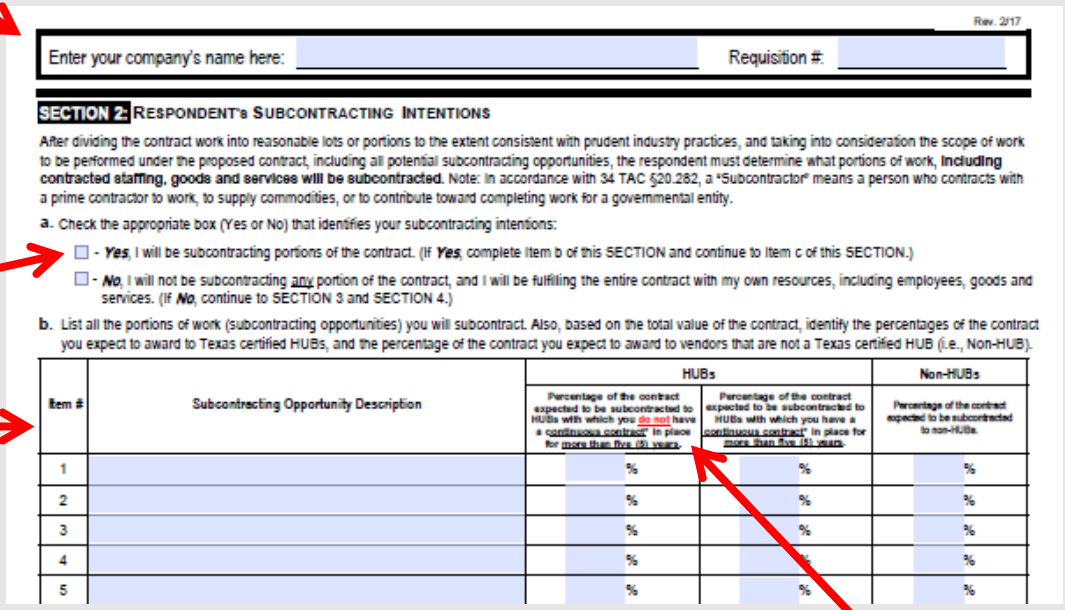
Page 2

Enter your Company's name and the requisition #. *(Enter this information on each subsequent page.)*

Section 2: Respondents Subcontracting Intentions

2a: ✓ Yes, I will be subcontracting portions of the contract.

2b: List all the portions of work you will be subcontracting to HUBs and the % of the contract you expect to award.



Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION 2: RESPONDENT'S SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods and services will be subcontracted**. Note: In accordance with 34 TAC §20.282, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☐ - ***Yes***, I will be subcontracting portions of the contract. (If ***Yes***, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - ***No***, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods and services. (If ***No***, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a continuous contract in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to HUBs with which you have a continuous contract in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to non-HUBs.
1		%	%	%
2		%	%	%
3		%	%	%
4		%	%	%
5		%	%	%

NOTE: Must meet or exceed HUB goal using HUBs with which you **do not** have a **continuous contract** in place for **more than five (5) years**.

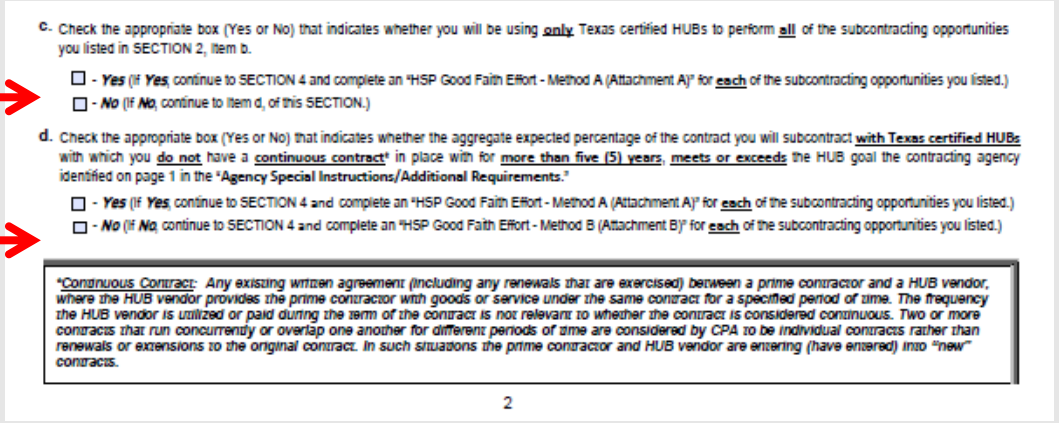
HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

Page 2 (cont.)

Section 2: Respondents Subcontracting Intentions

2c: ✓ No, to indicate you will NOT be only using HUBs.

2d: ✓ Yes, indicating you do NOT have a continuous contract in place for 5 or more years.



c. Check the appropriate box (Yes or No) that indicates whether you will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities you listed in SECTION 2, item b.

☐ - ***Yes*** (If ***Yes***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - ***No*** (If ***No***, continue to item d, of this SECTION.)

d. Check the appropriate box (Yes or No) that indicates whether the aggregate expected percentage of the contract you will subcontract **with Texas certified HUBs** with which you **do not** have a **continuous contract*** in place with for **more than five (5) years**, **meets or exceeds** the HUB goal the contracting agency identified on page 1 in the "**Agency Special Instructions/Additional Requirements.**"

☐ - ***Yes*** (If ***Yes***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - ***No*** (If ***No***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed.)

*Continuous Contract: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.

2

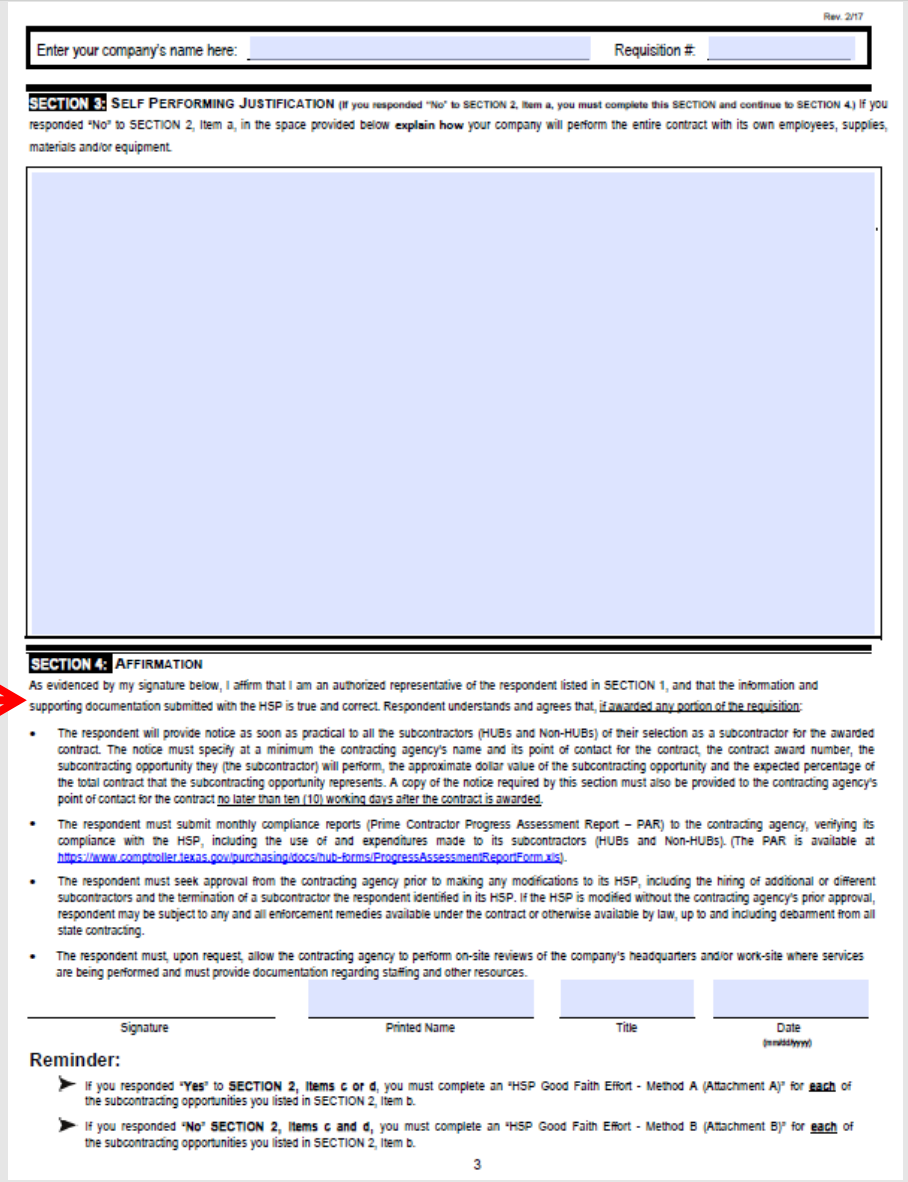
HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

Page 3

Section 4: Affirmation

Read, sign and date to affirm the information you provided is true and correct.

Move on to "HSP Good Faith Effort – Method A (Attachment A)"



Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION 3: SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.) If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment.

SECTION 4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/ProgressAssessmentReportForm.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

Signature | Printed Name | Title | Date (mm/dd/yyyy)

Reminder:

- If you responded **"Yes"** to **SECTION 2, Items c or d**, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded **"No" SECTION 2, Items c and d**, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in SECTION 2, Item b.

3

HSP Completion: Option 2 – Meeting TxDOT's HUB Goal

HSP Good Faith Effort – Method A (Attachment A)

Complete this form for each subcontract opportunity listed in Section 2(b) of the HSP.

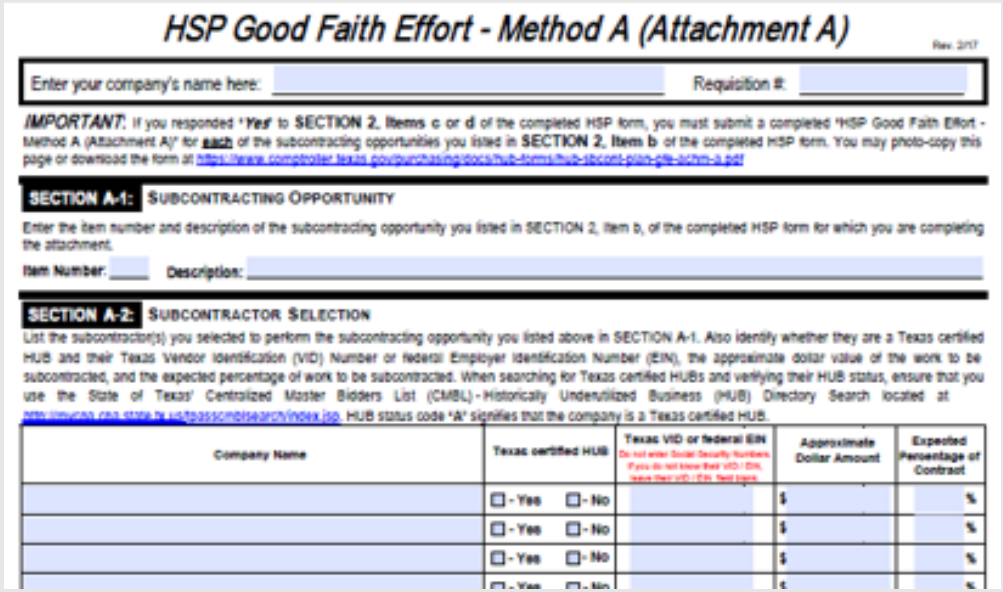
Section A-1:

List the information requested from the subcontracting opportunity.

Section A-2:

Provide all information requested.

Don't put 'To Be Determined (TBD)' under company name.



HSP Good Faith Effort - Method A (Attachment A)

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Enter your company's name here: _____ Requisition #: _____

IMPORTANT: If you responded '*Yes*' to **SECTION 2, Items c** or **d** of the completed HSP form, you must submit a completed 'HSP Good Faith Effort - Method A (Attachment A)' for **each** of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/hub-sbcont-plan-gfe-achm-a.pdf

SECTION A-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: ____ Description: _____

SECTION A-2: SUBCONTRACTOR SELECTION

List the subcontractor(s) you selected to perform the subcontracting opportunity you listed above in SECTION A-1. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://www.cpa.state.tx.us/cpa/cmblsearch/index.jsp. HUB status code 'A' signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN (Do not enter Social Security Numbers. If you do not know their VID / EIN, leave that VID / EIN field blank.)	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

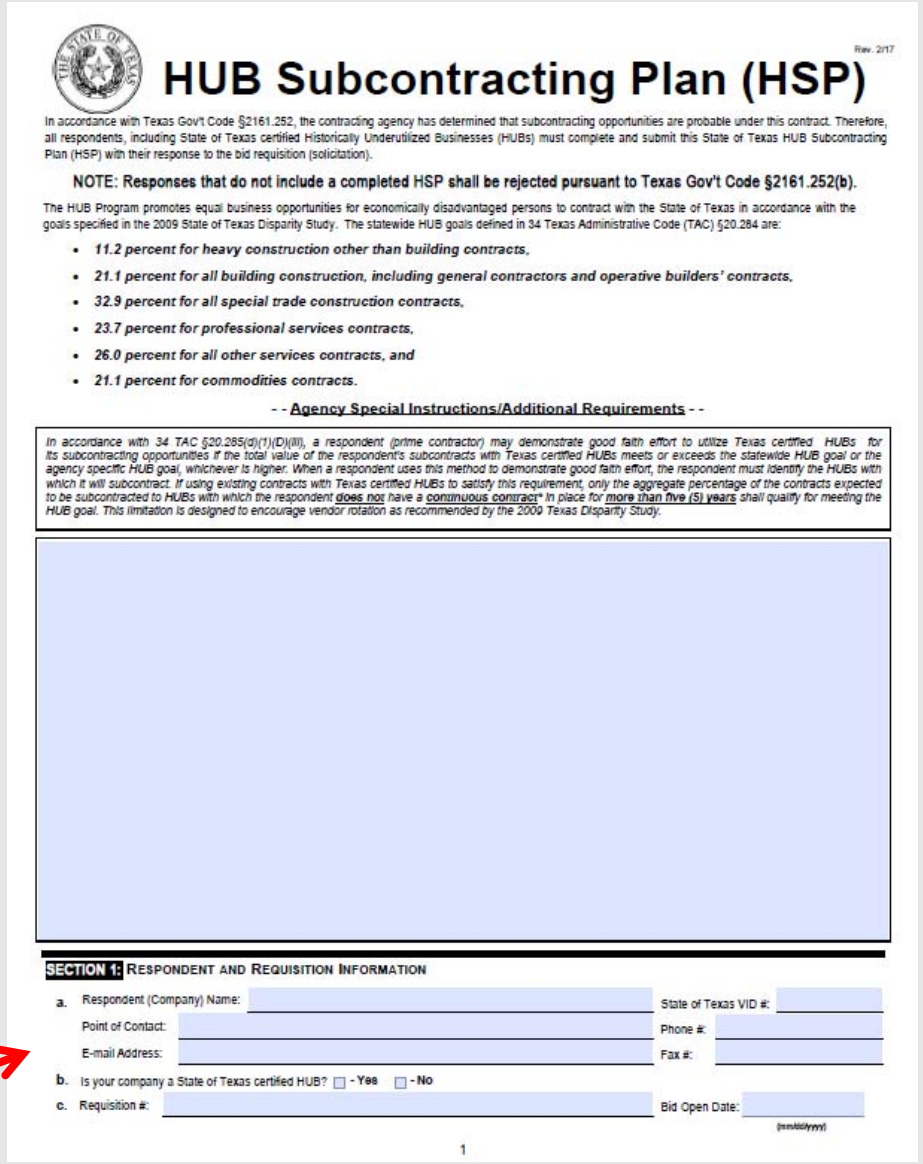
HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

If you are subcontracting with HUBs and Non-HUBs, and you do not meet or exceed the aggregate percentage (HUB Goal) of subcontracting with HUBs, complete the following:

- Section 1 – Respondent and Requisition Information (Page 1);
- Section 2a – Yes, I will be subcontracting portions of the contract (Page 2);
- Section 2b – List all the portions of work you will subcontract, and indicate the percentage of the contract you expect to award to HUB vendors (Page 2 and the continuation sheet as needed);
- Section 2c – No, I will not be using only Texas certified HUBs to perform all of the subcontracting opportunities listed (Page 2);
- Section 2d – No, the aggregate expected percentage of the contract you will subcontract with Texas certified HUBs, which you have a continuous contract in place for five (5) years or less, does not meet or exceed the HUB goal in the solicitation (Page 2)
- Section 4 – Affirmation that all information and supporting documentation submitted is true and correct (Page 3); and,
- HSP GFE Method B (Attachment B) – Complete this attachment for each subcontracting opportunity (Page 1 of 1).

HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

Page 1



Rev. 2/17

HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.284 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.285(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

SECTION 1: RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: _____ State of Texas VID #: _____

Point of Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

b. Is your company a State of Texas certified HUB? ☐ - Yes ☐ - No

c. Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

1

Section 1: Respondent and Requisition Information

Complete all information requested.

HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

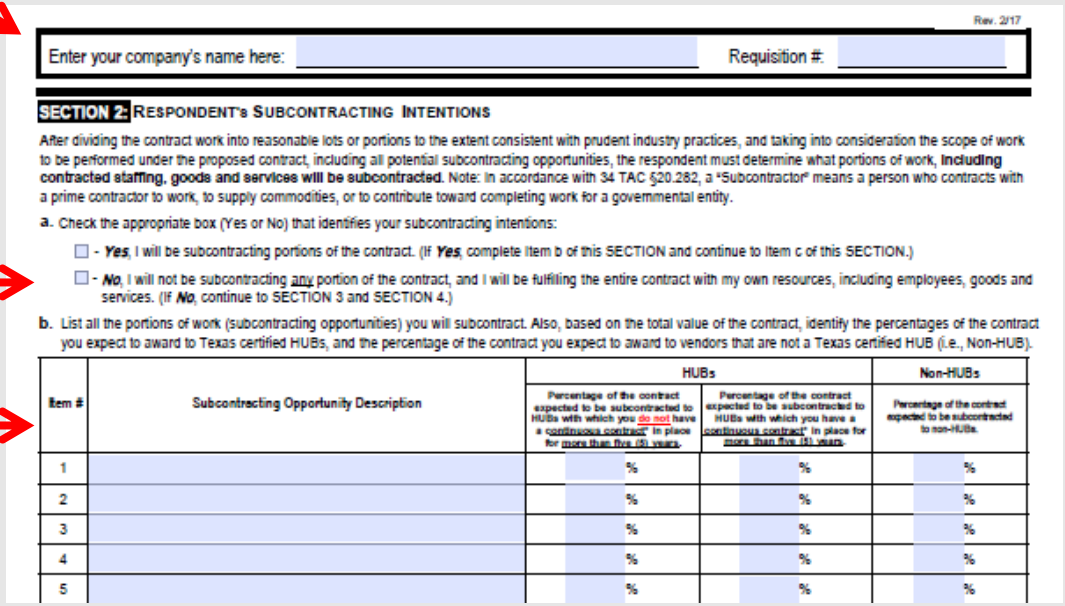
Page 2

Enter your Company's name and the requisition #. *(Enter this information on each subsequent page.)*

Section 2: Respondents Subcontracting Intentions

2a: ✓ Yes, I will be subcontracting portions of the contract.

2b: List all the portions of work you will be subcontracting to HUBs and the % of the contract you expect to award.



Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION 2: RESPONDENT'S SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods and services will be subcontracted**. Note: In accordance with 34 TAC §20.282, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☐ - ***Yes***, I will be subcontracting portions of the contract. (If ***Yes***, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - ***No***, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods and services. (If ***No***, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a "continuous contract" in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to HUBs with which you have a "continuous contract" in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to non-HUBs.
1		%	%	%
2		%	%	%
3		%	%	%
4		%	%	%
5		%	%	%

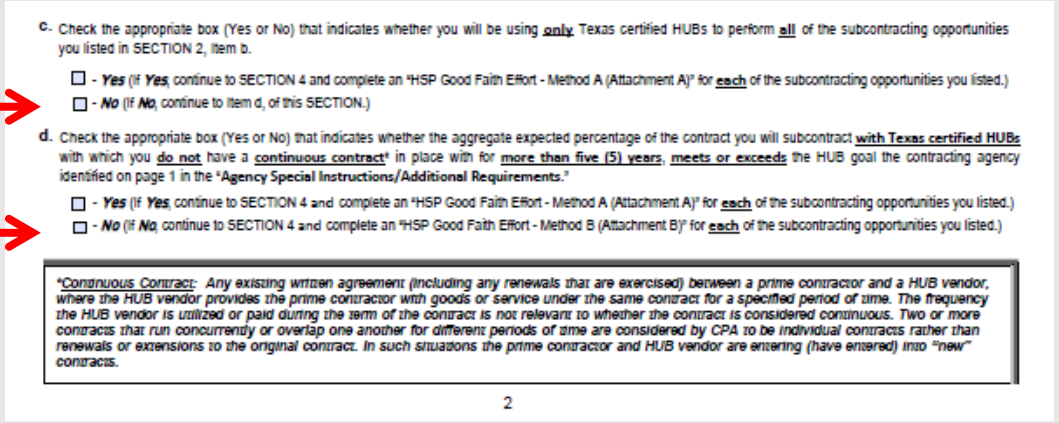
HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

Page 2 (cont.)

Section 2: Respondents Subcontracting Intentions

2c: ✓ No, to indicate you will NOT be only using HUBs.

2d: ✓ No, indicating you do NOT have a continuous contract in place for 5 or more years.



c. Check the appropriate box (Yes or No) that indicates whether you will be using **only** Texas certified HUBs to perform **all** of the subcontracting opportunities you listed in SECTION 2, item b.

☐ - ***Yes*** (If ***Yes***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - ***No*** (If ***No***, continue to item d, of this SECTION.)

d. Check the appropriate box (Yes or No) that indicates whether the aggregate expected percentage of the contract you will subcontract **with Texas certified HUBs** with which you **do not** have a **continuous contract*** in place with for **more than five (5) years**, **meets or exceeds** the HUB goal the contracting agency identified on page 1 in the "**Agency Special Instructions/Additional Requirements.**"

☐ - ***Yes*** (If ***Yes***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed.)

☐ - ***No*** (If ***No***, continue to SECTION 4 and complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed.)

*Continuous Contract: Any existing written agreement (including any renewals that are exercised) between a prime contractor and a HUB vendor, where the HUB vendor provides the prime contractor with goods or service under the same contract for a specified period of time. The frequency the HUB vendor is utilized or paid during the term of the contract is not relevant to whether the contract is considered continuous. Two or more contracts that run concurrently or overlap one another for different periods of time are considered by CPA to be individual contracts rather than renewals or extensions to the original contract. In such situations the prime contractor and HUB vendor are entering (have entered) into "new" contracts.

2

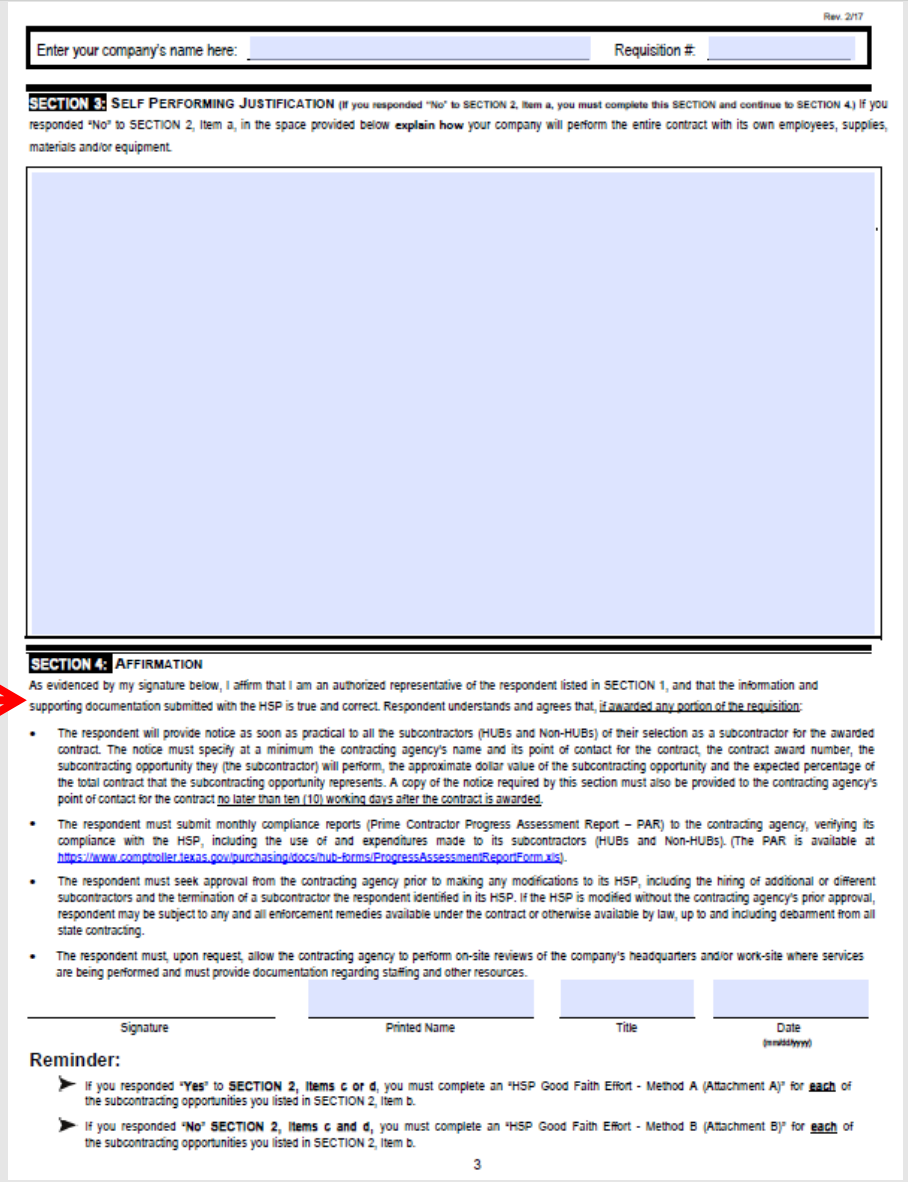
HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

Page 3

Section 4: Affirmation

Read, sign and date to affirm the information you provided is true and correct.

Move on to "HSP Good Faith Effort – Method B (Attachment B)"



Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION 3: SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.) If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment.

SECTION 4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/ProgressAssessmentReportForm.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

Signature | Printed Name | Title | Date (mm/dd/yyyy)

Reminder:

- If you responded **"Yes"** to **SECTION 2, Items c or d**, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded **"No" SECTION 2, Items c and d**, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in SECTION 2, Item b.

3

HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

HSP Good Faith Effort – Method B (Attachment B) Page 1

Complete this form for each subcontract opportunity listed in Section 2(b) of the HSP.

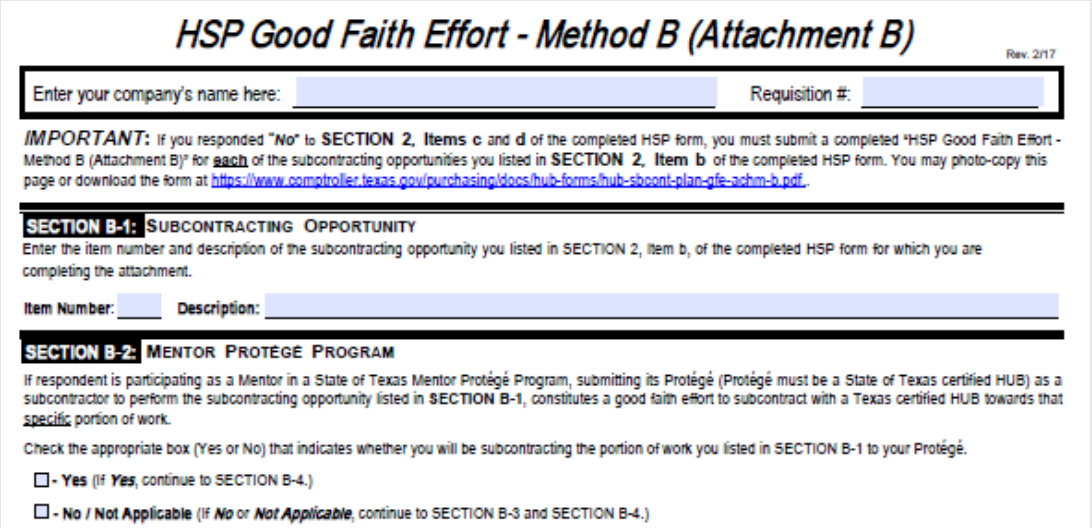
Section B-1:

Complete the information requested.

Section B-2:

If you are using your HUB Protégé, mark Yes and continue to Section B-4.

HSP Good Faith Effort – Method B (Attachment B), Page 2 of 2 <u>IF YOU MARK NO, CONTINUE TO SECTION B-3 and SECTION B-4.</u>



HSP Good Faith Effort - Method B (Attachment B)

Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

IMPORTANT: If you responded "*No*" to **SECTION 2, Items c** and **d** of the completed HSP form, you must submit a completed "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in **SECTION 2, Item b** of the completed HSP form. You may photo-copy this page or download the form at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/hub-sbcont-plan-gfe-achm-b.pdf.

SECTION B-1: SUBCONTRACTING OPPORTUNITY

Enter the item number and description of the subcontracting opportunity you listed in SECTION 2, Item b, of the completed HSP form for which you are completing the attachment.

Item Number: ____ **Description:** _____

SECTION B-2: MENTOR PROTÉGÉ PROGRAM

If respondent is participating as a Mentor in a State of Texas Mentor Protégé Program, submitting its Protégé (Protégé must be a State of Texas certified HUB) as a subcontractor to perform the subcontracting opportunity listed in **SECTION B-1**, constitutes a good faith effort to subcontract with a Texas certified HUB towards that specific portion of work.

Check the appropriate box (Yes or No) that indicates whether you will be subcontracting the portion of work you listed in SECTION B-1 to your Protégé.

☐ - **Yes** (If ***Yes***, continue to SECTION B-4.)

☐ - **No / Not Applicable** (If ***No*** or ***Not Applicable***, continue to SECTION B-3 and SECTION B-4.)

HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

HSP Good Faith Effort – Method B (Attachment B) Page 2

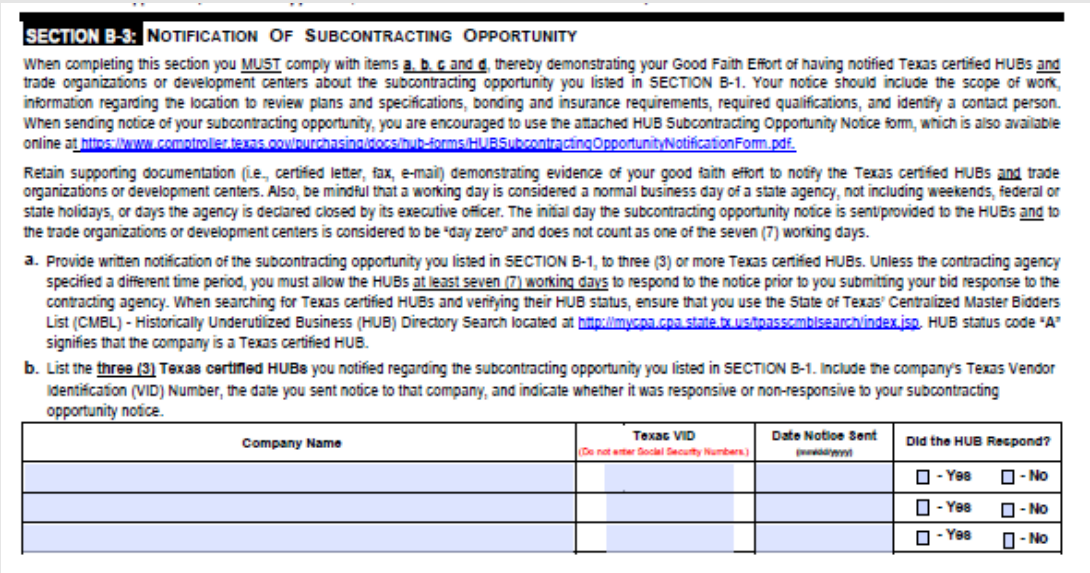
Section B-3:

You must comply with Items a, b, c and d. Retain documentation **(i.e., fax, email, certified letter)** demonstrating evidence of your good faith effort. You are encouraged to use the Notification Form located at the link provided or included. **The initial day the notice is sent counts as "Day Zero."**

You **MUST** submit supporting documentation with the HSP.

a. Allow the HUBs at least seven (7) working days to respond. The initial day notice is sent is considered "day zero" and does not count as one of the seven (7) working days.

b. List three (3) HUBs contacted for subcontracting opportunities.



SECTION B-3: NOTIFICATION OF SUBCONTRACTING OPPORTUNITY

When completing this section you MUST comply with items **a, b, c and d**, thereby demonstrating your Good Faith Effort of having notified Texas certified HUBs and trade organizations or development centers about the subcontracting opportunity you listed in SECTION B-1. Your notice should include the scope of work, information regarding the location to review plans and specifications, bonding and insurance requirements, required qualifications, and identify a contact person. When sending notice of your subcontracting opportunity, you are encouraged to use the attached HUB Subcontracting Opportunity Notice form, which is also available online at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/HUBSubcontractingOpportunityNotificationForm.pdf.

Retain supporting documentation (i.e., certified letter, fax, e-mail) demonstrating evidence of your good faith effort to notify the Texas certified HUBs and trade organizations or development centers. Also, be mindful that a working day is considered a normal business day of a state agency, not including weekends, federal or state holidays, or days the agency is declared closed by its executive officer. The initial day the subcontracting opportunity notice is sent/provided to the HUBs and to the trade organizations or development centers is considered to be "day zero" and does not count as one of the seven (7) working days.

a. Provide written notification of the subcontracting opportunity you listed in SECTION B-1, to three (3) or more Texas certified HUBs. Unless the contracting agency specified a different time period, you must allow the HUBs at least seven (7) working days to respond to the notice prior to you submitting your bid response to the contracting agency. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "A" signifies that the company is a Texas certified HUB.

b. List the **three (3) Texas certified HUBs** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the company's Texas Vendor Identification (VID) Number, the date you sent notice to that company, and indicate whether it was responsive or non-responsive to your subcontracting opportunity notice.

Company Name	Texas VID (Do not enter Social Security Numbers.)	Date Notice Sent (mm/dd/yyyy)	Did the HUB Respond?
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No
			☐ - Yes ☐ - No

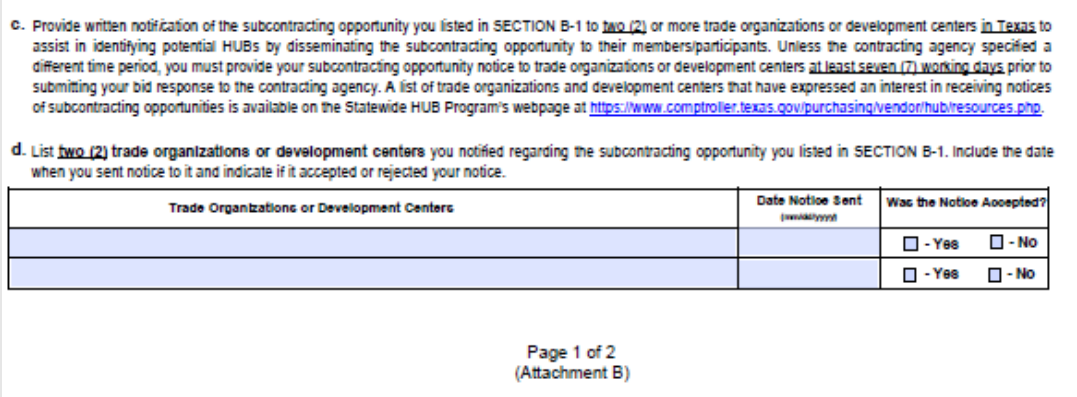
HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

HSP Good Faith Effort – Method B (Attachment B) Page 2

Section B-3 (cont.):

c. Provide your subcontracting opportunity notice to trade organizations or development centers at least seven (7) working days prior to submitting your bid response.

d. List two (2) trade organizations contacted for these subcontracting opportunities



c. Provide written notification of the subcontracting opportunity you listed in SECTION B-1 to two (2) or more trade organizations or development centers in Texas to assist in identifying potential HUBs by disseminating the subcontracting opportunity to their members/participants. Unless the contracting agency specified a different time period, you must provide your subcontracting opportunity notice to trade organizations or development centers at least seven (7) working days prior to submitting your bid response to the contracting agency. A list of trade organizations and development centers that have expressed an interest in receiving notices of subcontracting opportunities is available on the Statewide HUB Program's webpage at https://www.comptroller.texas.gov/purchasing/vendor/hub/resources.php.

d. List **two (2) trade organizations or development centers** you notified regarding the subcontracting opportunity you listed in SECTION B-1. Include the date when you sent notice to it and indicate if it accepted or rejected your notice.

Trade Organizations or Development Centers	Date Notice Sent (mm/dd/yyyy)	Was the Notice Accepted?
		☐ - Yes ☐ - No
		☐ - Yes ☐ - No

Page 1 of 2
(Attachment B)

HSP Completion: Option 3 – Not Meeting TxDOT's HUB Goal

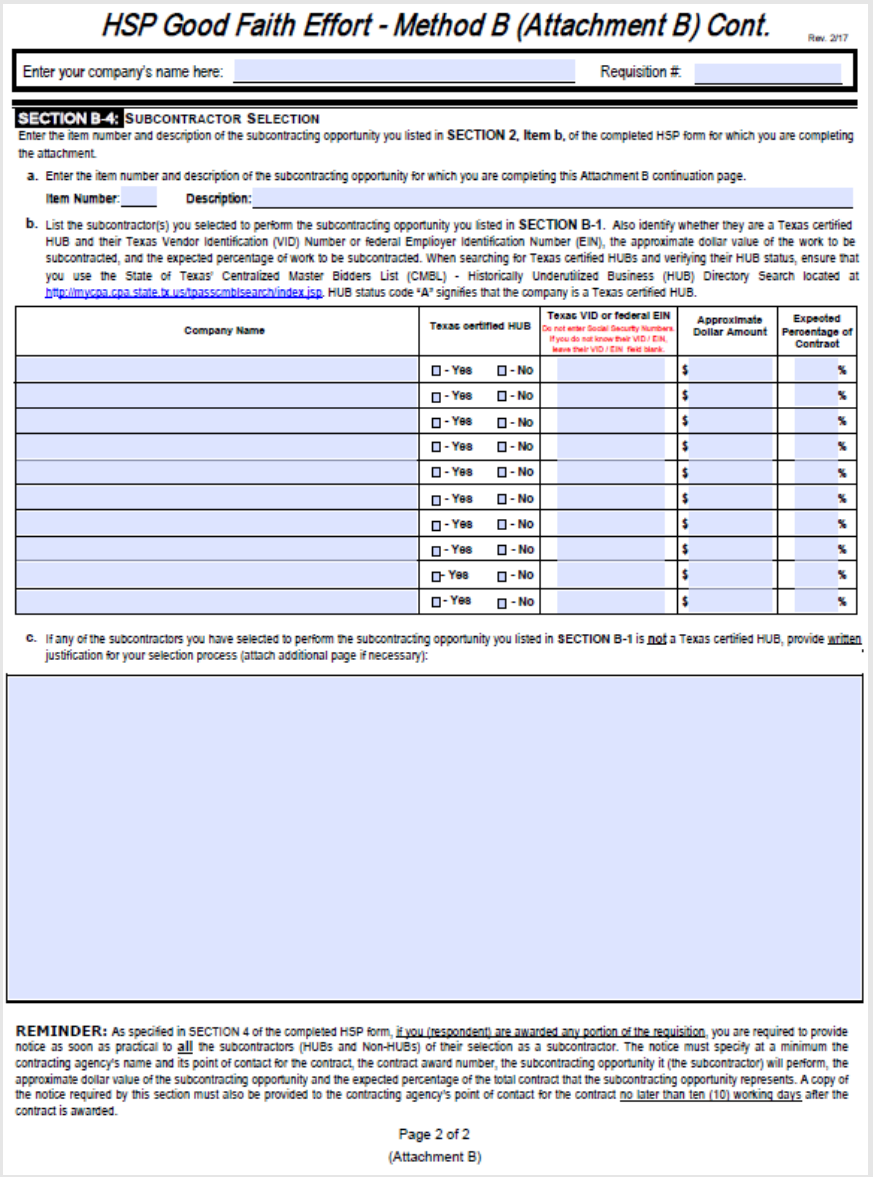
HSP Good Faith Effort – Method B (Attachment B) Page 2

Section B-4:

a. Subcontracting opportunity information.

b. Enter each selected subcontractor and provide all other information in this field. **Don't put 'To Be Determined (TBD)' under company name.**

c. Provide written justification as to why a HUB was not selected for this subcontracting opportunity.



HSP Good Faith Effort - Method B (Attachment B) Cont. Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION B-4: SUBCONTRACTOR SELECTION

Enter the item number and description of the subcontracting opportunity you listed in **SECTION 2, Item b,** of the completed HSP form for which you are completing the attachment.

a. Enter the item number and description of the subcontracting opportunity for which you are completing this Attachment B continuation page.

Item Number: ____ **Description:** _____

b. List the subcontractor(s) you selected to perform the subcontracting opportunity you listed in **SECTION B-1**. Also identify whether they are a Texas certified HUB and their Texas Vendor Identification (VID) Number or federal Employer Identification Number (EIN), the approximate dollar value of the work to be subcontracted, and the expected percentage of work to be subcontracted. When searching for Texas certified HUBs and verifying their HUB status, ensure that you use the State of Texas' Centralized Master Bidders List (CMBL) - Historically Underutilized Business (HUB) Directory Search located at http://mycpa.cpa.state.tx.us/tpasscmblsearch/index.jsp. HUB status code "A" signifies that the company is a Texas certified HUB.

Company Name	Texas certified HUB	Texas VID or federal EIN (Do not enter Social Security Numbers. If you do not know their VID / EIN, leave their VID / EIN field blank.)	Approximate Dollar Amount	Expected Percentage of Contract
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%
	☐ - Yes ☐ - No		$	%

c. If any of the subcontractors you have selected to perform the subcontracting opportunity you listed in **SECTION B-1** is **not** a Texas certified HUB, provide written justification for your selection process (attach additional page if necessary):

REMINDER: As specified in SECTION 4 of the completed HSP form, if you (respondent) are awarded any portion of the requisition, you are required to provide notice as soon as practical to **all** the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity it (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.

Page 2 of 2
(Attachment B)

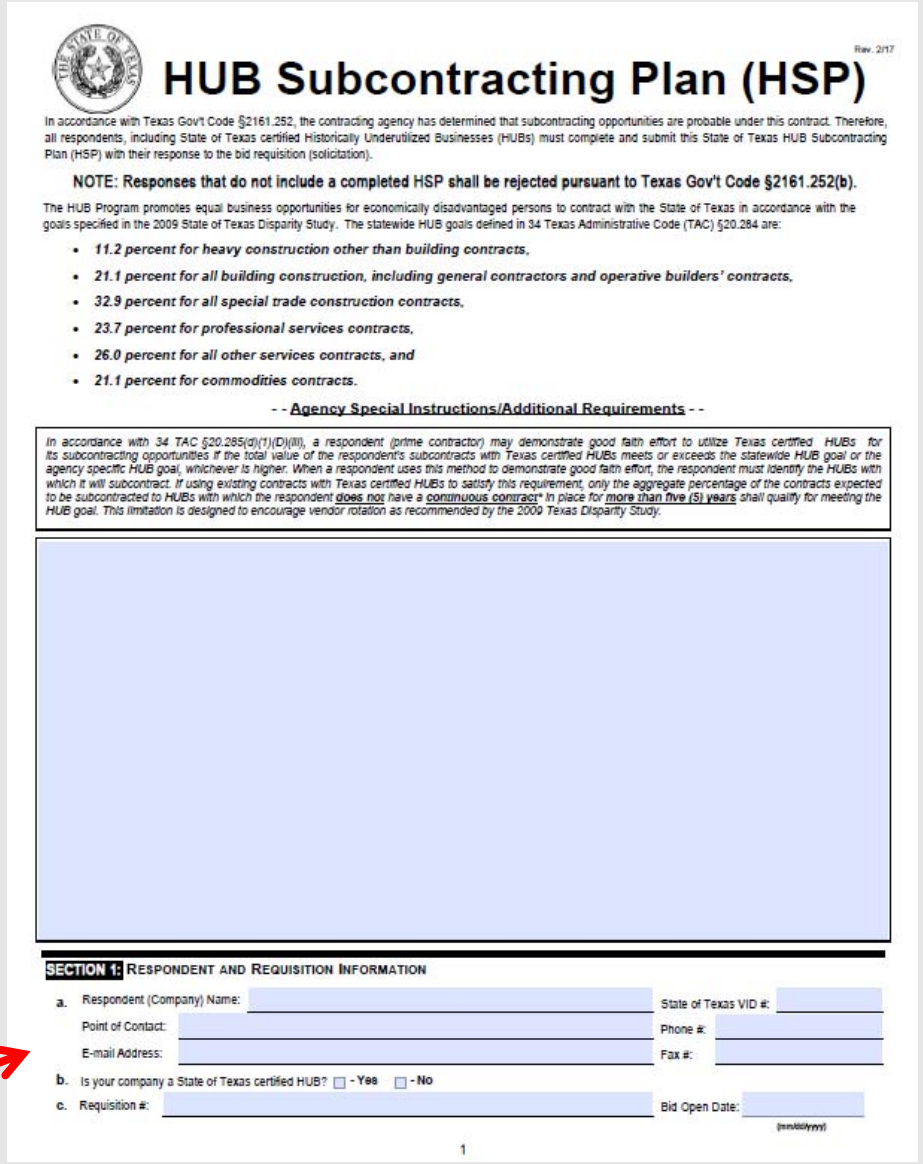
HSP Completion: Option 4 – Self-Performing

If you are not subcontracting any portion of the contract and will be fulfilling the entire contract with your own resources (i.e., equipment, supplies, materials, and/or employees), complete the following in the HSP:

- Section 1 – Respondent and Requisition Information (Page 1);
- Section 2 a – No, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources (Page 2);
- Section 3 – Self Performing Justification that explains how your company will fulfill the entire contract with its own resources (Page 3); and
- Section 4 – Affirmation that all information and supporting documentation submitted is true and correct (Page 3).

HSP Completion: Option 4 – Self-Performing

Page 1



Rev. 2/17

HUB Subcontracting Plan (HSP)

In accordance with Texas Gov't Code §2161.252, the contracting agency has determined that subcontracting opportunities are probable under this contract. Therefore, all respondents, including State of Texas certified Historically Underutilized Businesses (HUBs) must complete and submit this State of Texas HUB Subcontracting Plan (HSP) with their response to the bid requisition (solicitation).

NOTE: Responses that do not include a completed HSP shall be rejected pursuant to Texas Gov't Code §2161.252(b).

The HUB Program promotes equal business opportunities for economically disadvantaged persons to contract with the State of Texas in accordance with the goals specified in the 2009 State of Texas Disparity Study. The statewide HUB goals defined in 34 Texas Administrative Code (TAC) §20.284 are:

- ***11.2 percent for heavy construction other than building contracts,***
- ***21.1 percent for all building construction, including general contractors and operative builders' contracts,***
- ***32.9 percent for all special trade construction contracts,***
- ***23.7 percent for professional services contracts,***
- ***26.0 percent for all other services contracts, and***
- ***21.1 percent for commodities contracts.***

- - Agency Special Instructions/Additional Requirements - -

*In accordance with 34 TAC §20.285(d)(1)(D)(iii), a respondent (prime contractor) may demonstrate good faith effort to utilize Texas certified HUBs for its subcontracting opportunities if the total value of the respondent's subcontracts with Texas certified HUBs meets or exceeds the statewide HUB goal or the agency specific HUB goal, whichever is higher. When a respondent uses this method to demonstrate good faith effort, the respondent must identify the HUBs with which it will subcontract. If using existing contracts with Texas certified HUBs to satisfy this requirement, only the aggregate percentage of the contracts expected to be subcontracted to HUBs with which the respondent **does not** have a **continuous contract*** in place for **more than five (5) years** shall qualify for meeting the HUB goal. This limitation is designed to encourage vendor rotation as recommended by the 2009 Texas Disparity Study.*

SECTION 1: RESPONDENT AND REQUISITION INFORMATION

a. Respondent (Company) Name: _____ State of Texas VID #: _____

Point of Contact: _____ Phone #: _____

E-mail Address: _____ Fax #: _____

b. Is your company a State of Texas certified HUB? ☐ - Yes ☐ - No

c. Requisition #: _____ Bid Open Date: _____ (mm/dd/yyyy)

1

Section 1: Respondent and Requisition Information

Complete all information requested.

HSP Completion: Option 4 – Self-Performing

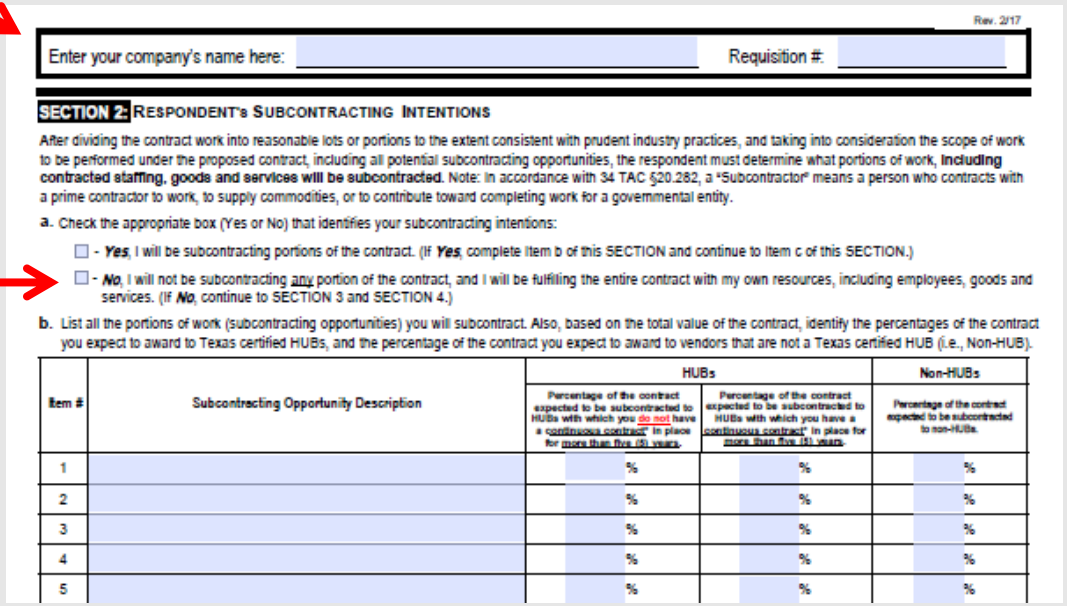
Page 2

Enter your Company's name and the requisition #. *(Enter this information on each subsequent page.)*

Section 2: Respondents Subcontracting Intentions

2a: ✓ No, I will not be subcontracting any portion of the contract.

Move on to Page 3, Section 3.



Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION 2: RESPONDENT'S SUBCONTRACTING INTENTIONS

After dividing the contract work into reasonable lots or portions to the extent consistent with prudent industry practices, and taking into consideration the scope of work to be performed under the proposed contract, including all potential subcontracting opportunities, the respondent must determine what portions of work, **including contracted staffing, goods and services will be subcontracted**. Note: In accordance with 34 TAC §20.282, a "Subcontractor" means a person who contracts with a prime contractor to work, to supply commodities, or to contribute toward completing work for a governmental entity.

a. Check the appropriate box (Yes or No) that identifies your subcontracting intentions:

☐ - ***Yes***, I will be subcontracting portions of the contract. (If ***Yes***, complete Item b of this SECTION and continue to Item c of this SECTION.)

☐ - ***No***, I will not be subcontracting any portion of the contract, and I will be fulfilling the entire contract with my own resources, including employees, goods and services. (If ***No***, continue to SECTION 3 and SECTION 4.)

b. List all the portions of work (subcontracting opportunities) you will subcontract. Also, based on the total value of the contract, identify the percentages of the contract you expect to award to Texas certified HUBs, and the percentage of the contract you expect to award to vendors that are not a Texas certified HUB (i.e., Non-HUB).

Item #	Subcontracting Opportunity Description	HUBs		Non-HUBs
		Percentage of the contract expected to be subcontracted to HUBs with which you do not have a "continuous contract" in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to HUBs with which you have a "continuous contract" in place for more than five (5) years.	Percentage of the contract expected to be subcontracted to non-HUBs.
1		%	%	%
2		%	%	%
3		%	%	%
4		%	%	%
5		%	%	%

HSP Completion: Option 4 – Self-Performing

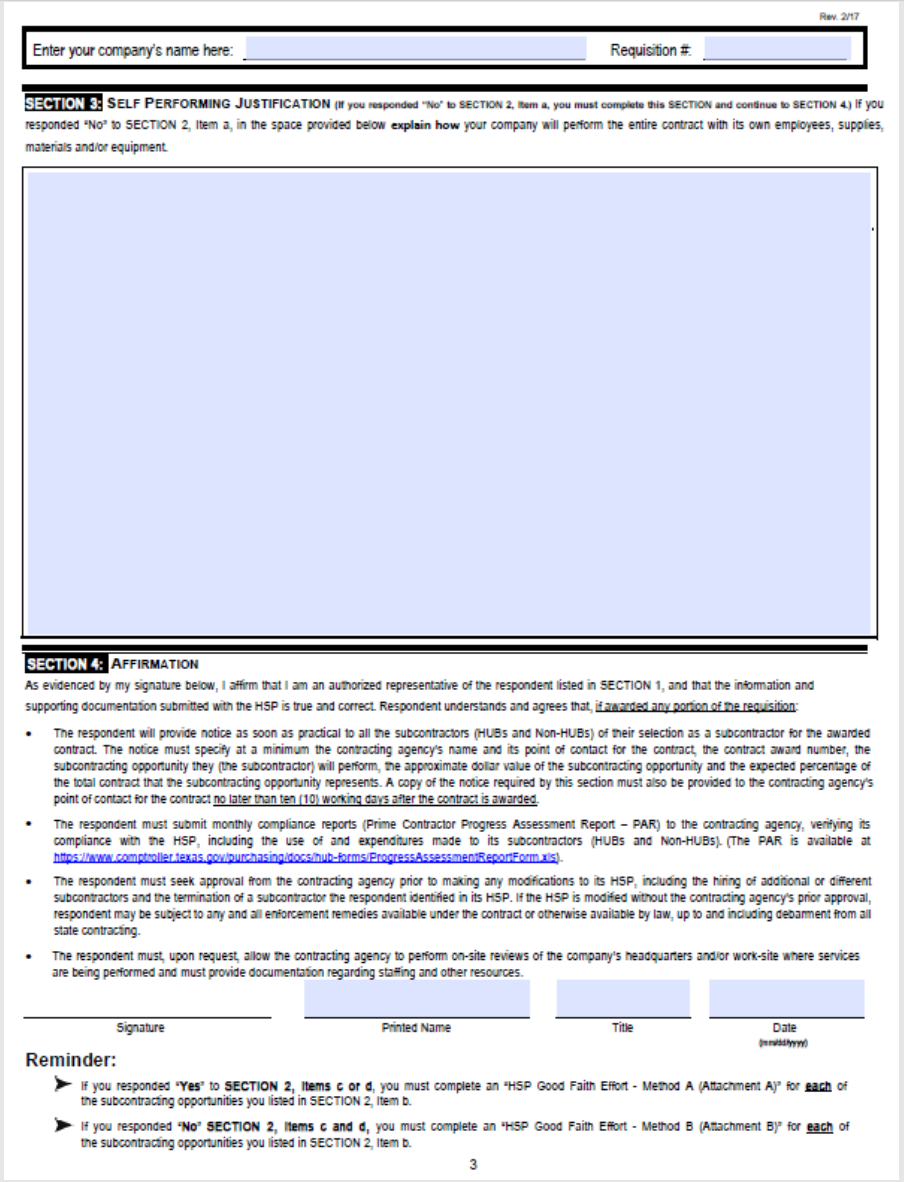
Page 3

Section 3: Self Performing Justification

In the space provided, list the specific page(s)/section(s) of your proposal response, which explains how your company will perform the entire contract with its own equipment, supplies, materials and/or employees.

Section 4: Affirmation

Read, sign and date to affirm the information you provided is true and correct.



Rev. 2/17

Enter your company's name here: _____ Requisition #: _____

SECTION 3: SELF PERFORMING JUSTIFICATION (If you responded "No" to SECTION 2, Item a, you must complete this SECTION and continue to SECTION 4.) If you responded "No" to SECTION 2, Item a, in the space provided below **explain how** your company will perform the entire contract with its own employees, supplies, materials and/or equipment.

SECTION 4: AFFIRMATION

As evidenced by my signature below, I affirm that I am an authorized representative of the respondent listed in SECTION 1, and that the information and supporting documentation submitted with the HSP is true and correct. Respondent understands and agrees that, if awarded any portion of the requisition:

- The respondent will provide notice as soon as practical to all the subcontractors (HUBs and Non-HUBs) of their selection as a subcontractor for the awarded contract. The notice must specify at a minimum the contracting agency's name and its point of contact for the contract, the contract award number, the subcontracting opportunity they (the subcontractor) will perform, the approximate dollar value of the subcontracting opportunity and the expected percentage of the total contract that the subcontracting opportunity represents. A copy of the notice required by this section must also be provided to the contracting agency's point of contact for the contract no later than ten (10) working days after the contract is awarded.
- The respondent must submit monthly compliance reports (Prime Contractor Progress Assessment Report – PAR) to the contracting agency, verifying its compliance with the HSP, including the use of and expenditures made to its subcontractors (HUBs and Non-HUBs). (The PAR is available at https://www.comptroller.texas.gov/purchasing/docs/hub-forms/ProgressAssessmentReportForm.xls).
- The respondent must seek approval from the contracting agency prior to making any modifications to its HSP, including the hiring of additional or different subcontractors and the termination of a subcontractor the respondent identified in its HSP. If the HSP is modified without the contracting agency's prior approval, respondent may be subject to any and all enforcement remedies available under the contract or otherwise available by law, up to and including debarment from all state contracting.
- The respondent must, upon request, allow the contracting agency to perform on-site reviews of the company's headquarters and/or work-site where services are being performed and must provide documentation regarding staffing and other resources.

Signature | Printed Name | Title | Date (mm/dd/yyyy)

Reminder:

- If you responded **"Yes"** to **SECTION 2, Items c or d**, you must complete an "HSP Good Faith Effort - Method A (Attachment A)" for **each** of the subcontracting opportunities you listed in SECTION 2, Item b.
- If you responded **"No" SECTION 2, Items c and d**, you must complete an "HSP Good Faith Effort - Method B (Attachment B)" for **each** of the subcontracting opportunities you listed in SECTION 2, Item b.

3

Contact Information

Texas Department of Transportation

Civil Rights Division
125 East 11th St.
Austin, TX 78701

(512) 416-4700
CIV_HUB@txdot.gov
www.txdot.gov

Texas Department of Transportation

SPECIFICATIONS

MCKINNEY AREA ENGINEERING AND
MAINTENANCE FACILITY

Site No: 189799
Building No:
188196 - Administration With Shop, Lab And Truck Wash
188197 –Vehicle Storage Shed

DALLAS DISTRICT(18)
COLLIN COUNTY , TEXAS

Project No: 18-470420012

TEXAS DEPARTMENT of TRANSPORTATION
125 E. 11th Street
Austin, Texas 78701

Support Services Division
Facilities Planning & Management Section
Riverside Annex, Bldg. 150-4 North

Date: 04/21/2021

TABLE of CONTENTS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

DIVISION 08 - OPENINGS

DIVISION 09 - FINISHES

DIVISION 10 - SPECIALTIES

DIVISION 11 - EQUIPMENT

NONE

DIVISION 12 - FURNISHINGS

DIVISION 13 – SPECIAL CONSTRUCTION

DIVISION 14 – CONVEYING EQUIPMENT

NONE

DIVISION 21 – FIRE SUPPRESSION

NONE

DIVISION 22 - PLUMBING

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

DIVISION 26 - ELECTRICAL

END OF SECTION

DOCUMENT 000107 - SEALS PAGE

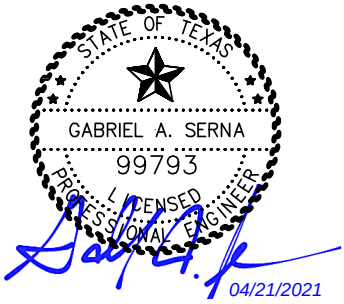
1.1 DESIGN PROFESSIONALS OF RECORD

A. Architect:

1. Steven Tremmel
2. Texas Architect #19414
3. Firm: Jacobs
4. Responsible for Divisions 01-49 Sections except where indicated as prepared by other design professionals of record.

B. Landscape Architect:

1. Chad St.John
2. Texas Landscape Architect #2154
3. Firm: Jacobs
4. Responsible for Division 32, except 323119.53.



C. Structural Engineer:

1. Gabriel Serna, PE
2. Texas PE #99793.
3. Firm: Jacobs
4. Responsible for Division 03, 04 and 05.

D. Telecommunications Design:

1. Brandon Houk, RCCD.
2. #183352R.
3. Responsible for Division 27 and 28.

E. HVAC Engineer / Plumbing Engineer:

1. Ken Meline, PE.
2. Texas PE #61722.
3. Responsible for Division 22 and 23.

04/21/21

F. Electrical Engineer:

1. John Haley, PE.
2. Texas PE #112905.
3. Responsible for Division 26.

04/21/21

END OF DOCUMENT 000107

DOCUMENT 003126 - EXISTING HAZARDOUS MATERIAL INFORMATION

1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.

B. An existing asbestos report for Project, prepared by Garner & Associates, dated October 28, 2020, is available for viewing as appended to this Document.

C. Related Requirements:

1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
2. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to bidders.
3. Document 003132 "Geotechnical Data" for reports and soil-boring data from geotechnical investigations that are made available to bidders.
4. Section 024116 "Structure Demolition"" for notification requirements if materials suspected of containing hazardous materials are encountered.

END OF DOCUMENT 003126

October 28, 2020

VIA: E-Mail (32 Pages)

Mr. Clay Hathorn
Facilities Coordinator
TxDOT
1805 N. Timberland Dr.
Lufkin, Texas 75901

Re: Supplemental Asbestos Survey/Testing Services
TxDOT Mckinney
Site No. 189779 - Bldgs. No. 188059, 188060, 188064 & 188065
2205 Tx-5, Mckinney, Texas 75069

Dear Mr. Hawthorn:

Garner & Associates, Inc., (G&A) has completed the Supplemental Asbestos Survey Consulting Services. The field services for the asbestos testing were conducted on August 18 & October 27, 2020. **The Scope of Work was to inspect and sample suspect asbestos-containing materials not previously identified in the Law Engineering (Law) reports provided and to also confirm the Law reports findings. Refer to the Law report for additional information on their findings, sample locations, etc** This report includes a summary of findings from the asbestos-containing materials sampling services conducted by G&A. The drawings included in this report are from field notes only and shall not be used by others for th purpose of abatement design/specifications. Field verifying confirmed asbestos-containing material locations must be conducted by a Licensed Consultant during the design/specification phase.

SUMMARY OF SURVEY/SAMPLING FINDINGS:

The sampling was conducted by an experienced DSHS Licensed Asbestos Inspectors with US EPA AHERA Inspector Accreditation. The report was completed by an experienced DSHS Licensed Asbestos Consultant with US EPA AHERA Inspector Accreditation, US EPA Management Planner, US EPA Accreditation and OSHA Project Designer Accreditation. Bulk samples were analyzed by an **independent** DSHS Licensed and NVLAP Accredited laboratory (Re: Table No. 1, 2, 3 & 4 - PLM Bulk Sample Analysis Results and the Appendix for the laboratory PLM report and Floor Plan). Bulk samples were analyzed by visual estimation, utilizing Polarized Light Microscopy (PLM) analysis the US EPA approved method for bulk sample analysis.

Asbestos-containing materials identified on and within the buildings;

Building 188059
Floor Tile with Mastic (Identified in Law Engineering's Report & by G&A)
Window Glazing Compound (Identified in Law Engineering's Report & by G&A)
Furnace Vent Tape (Identified in Law Engineering's Report)
Cement Panels and Boiler Vent Pipe (Identified in Law Engineering's Report)
Drywall Joint Compound & Texture (Identified by G&A)
Ceiling Tile (Identified by G&A)
***The cement-asbestos siding listed in the Law Engineering report appeared to have been removed and replaced with vinyl. Refer to the Law report for the Furnace location and Cement Panel and Flue.**

Building 188060
Floor Tile and Mastic (Identified in Law Engineering's Report & by G&A)
Drywall Joint Compound & Texture (Identified by G&A)
Window Glazing Compound (Identified in Law Engineering's Report & by G&A)
***The cement-asbestos siding listed in the Law Engineering report appeared to have been removed and replaced with vinyl.**

Building 188064
Floor Tile and Mastic (Identified in Law Engineering's Report & by G&A)
Drywall Joint Compound & Texture (Identified by G&A)
Pipe Wrap & Penetration Packing (Identified in Law Engineering's Report)
Window Glazing Compound (Identified in Law Engineering's Report & by G&A)
Exterior Siding Texture (Identified by G&A)

Building 188065
Drywall Joint Compound & Texture (Identified by G&A)
Window Glazing Compound (Identified in Law Engineering's Report & by G&A)

All bulk samples obtained were analyzed by visual estimation, utilizing Polarized Light Microscopy (PLM) analysis (EPA AHERA 40 CFR Part 763 Appendix E to Subpart E) at the time of the Asbestos Testing Services. The US EPA/NESHAP Federal Register 40 CFR Part 61, Vol. 55, No. 224, November 20, 1990, and the US EPA May 8, 1991, Clarification Memorandum (entitled Clarification of NESHAP Requirement to Perform Point Counting to Quantify Asbestos Below 10%) indicates "...if the analyst detects asbestos in the sample and estimates the amount by visual estimation to be less than 10%, the owner or operator of the building may (1) elect to assume the amount to be greater than 1% and treat the material as asbestos-containing material or (2) require verification of the amount by point counting...if the result obtained by point count is different for a result obtained

by visual estimation, the point count result will be used."

The EPA allows for point count analysis at the Owner's option which may reduce the asbestos percentage to one (1) percent or less. The US EPA/NESHAP Federal Register 40 CFR Part 61, Vol. 55, No. 224, November 20, 1990 and the US EPA May 8, 1991 Clarification Memorandum regarding point counting defines friable and non-friable asbestos-containing material as "...any material containing **more than** one-percent asbestos...". The State of Texas Asbestos Health Protection Rules describes ACM as materials or products that contain more than one percent (1.0%) as determined by Environmental Protection Agency recommended methods. The US EPA AHERA regulations define asbestos-containing materials as "...any material or product which contains **more than** 1 percent asbestos." The Occupational Safety and Health Administration (OSHA), Department of Labor defines asbestos-containing materials as "...any material containing **more than** one percent asbestos."

RECOMMENDATIONS & REGULATORY REQUIREMENTS:

Asbestos is a regulated substance, its condition, handling and disposal are regulated by the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA) and the Texas Department of State Health Services (DSHS). All asbestos abatement work within a public building must be undertaken by licensed, qualified in-house personnel or a licensed, qualified Asbestos Abatement Contractor. Exterior Asbestos removal should be performed in compliance with the latest EPA, OSHA and DSHS regulations.

The Texas Department of State Health Services (DSHS) - Texas Asbestos Health Protection Rules (TAHPR) Section 295.34 (b) indicates, "the owner retains the primary responsibility for the presence, condition, disturbance, renovation, demolition, and disposal of any asbestos encountered in the construction, operations, maintenance, or furnishing of that building or facility...". DSHS has the delegated responsibility for enforcement of the EPA NESHAP. DSHS APBU May-August 1996 indicates "...parts of the various regulations listed as a reference in the rules are enforced...Any blatant OSHA violations noted in an asbestos inspection may be reported to OSHA by the department inspectors."

DSHS Regulations require building owners to remove friable and/or potentially friable asbestos-containing materials from areas intended to be renovated or demolished. All abatement activities are required to be conducted by a Licensed Asbestos Contractor and Registered Workers. All renovation, demolition and/or abatement activity involving more than 3 square or linear feet of friable asbestos-containing materials, within public buildings, are required by the Texas Department of State Health Services (TAHPR Section 295.47) to be designed (plans and specifications) by a Licensed Asbestos Consultant. "Notification shall be made to the department (DSHS) no less than 10 working days (not calendar days) prior to commencement of the activity and shall be submitted on the form specified by the department" (Form APB-5). For assistance in completing the DSHS Form APB-5

or other inquiries contact DSHS at 1-800-572-5548. DSHS requires as a minimum, baseline air samples, ambient air samples, project monitoring (by a Licensed Project Manager), visual clearance inspection (by a Licensed Asbestos Consultant) and clearance air sampling by a Licensed Air Monitoring Technician (under the License of a Licensed Air Monitoring Laboratory). Abatement methods should be approved by the regulatory agencies prior to commencing any renovation/demolition or abatement work. Refer to DSHS Texas Asbestos Health Protection Rules (TAHPR) for complete DSHS asbestos requirements.

The November 24, 2003, OSHA 1926.1101 (Construction Standard) Standard Interpretation - Compliance Requirements for Renovation Work Involving Material Containing Less Than 1% Asbestos indicates "items that do not contain > 1% asbestos are covered to at least some extent by the Construction Asbestos Standard." The Standard Interpretation indicates, "29 CFR 1926.1101 would apply even if neither asbestos permissible exposure limit (PEL) is exceeded. The standard contains numerous work practice requirements and prohibitions which apply, regardless of the exposure levels. However, only two of the requirements and three of the prohibitions must be observed in the case of work activities involving installed construction materials that do not contain > 1% asbestos. Those work practice requirements and prohibitions must be observed regardless of the exposure levels and of the percentage of asbestos in the installed construction materials are: ... wet methods ... to control employee exposures ... ; prompt clean-up and disposal of waste and debris contaminated with asbestos in leak tight containers ... ; ... each employer ... shall ensure that a "competent person" conducts an exposure assessment ... ; you must inform employees about the presence of materials containing <1 % asbestos when you know it is present." This Standard Interpretation can be reviewed in it's entirety at http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table= INTERPRETATION.

LIMITATIONS:

This report applies only to the Scope of Work described herein. This report describes existing conditions at the time of the services. Conditions of asbestos-containing materials may change as a result of damage, deterioration or other disturbance and may increase the potential for elevated fiber levels. This report applies only to accessible areas observed during our field services. Asbestos-containing materials may exist in concealed inaccessible enclosures, such as areas enclosed by permanent partitions, within brick/block wall cavities, chases, shafts, equipment, etc. Material locations and quantities vary. Although a good-faith effort was made to locate asbestos-containing materials in the area within the Scope of Work, extensive destructive inspection was not conducted due to the expense, potential exposure hazards and/or potential regulatory violation. Inspection and testing for lead-based paint, PCB-containing light ballast and/or other hazardous and/or regulated materials was not included in Garner & Associates, Inc.'s survey.

Per the DSHS TAHPR Rule this document (asbestos survey report) may not be used as a design (specification) for asbestos abatement. Design and/or abatement monitoring services were not

included in G&A's Scope of Work. G&A and/or its employees shall not be named as "Consultant" on the DSHS 10-Day Notification Form without prior contractual agreement and written consent from G&A. G&A makes no warranty and assumes no liability for the inappropriate use or misuse of this document.

We appreciate the opportunity to provide Asbestos Survey Consulting Services to you. If we can be of any further assistance or if there are any questions related to this report, please contact us.

Sincerely,

Drew M. Garner, Jr.
CEO
DSHS Asbestos Consultant
License No. 10-5001

Mike Garner
President
DSHS Asbestos Inspector
License No. 60-2138

TABLE NO. 1 - PLM BULK SAMPLE ANALYSIS RESULTS TXDOT MCKINNEY - BLDG. 188059 2205 TX-5, MCKINNEY, TEXAS 75069		
SAMPLE NO.	**LOCATION / TYPE OF MATERIAL**	**RESULTS**
01	Exterior, Wall Texture / Thick Yellow Paint	ND
02	Exterior, Wall Texture / Thick Yellow Paint	ND
03	Exterior, Wall Texture / Thick Yellow Paint	ND
04	Cubical Area / Floor Tile Mastic	ND 4-9% Chry.
05	Area Engineer's Office / Floor Tile Mastic	ND 4-9% Chry.
06	Restroom Area / Floor Tile Mastic	ND ND
07	Cubical Area / Drywall Texture	4-9% Chry.
08	Engineer's Office / Drywall Texture	ND
09	Restroom Area / Drywall Texture	ND
10	Break Room Area / Drywall Texture	4-9% Chry.
11	Water Fountain Area / Drywall Texture	4-9% Chry.
12	Cubical Area / Drywall Joint Compound	4-9% Chry.
13	Break Room / Drywall Joint Compound	4-9% Chry.
14	Hallway / Drywall Joint Compound	4-9% Chry.
15	Throughout / Ceiling Tile	1-3% Chry.

CHRY. - CHRYSOTILE ASBESTOS AMO. - AMOSITE ASBESTOS ANTHO. - ANTHOPHYLLITE ASBESTOS
TRACE OR <1% - LESS THAN 1% ASBESTOS ND - NONE DETECTED

TABLE NO. 1 - PLM BULK SAMPLE ANALYSIS RESULTS TXDOT MCKINNEY - BLDG. 188059 2205 TX-5, MCKINNEY, TEXAS 75069		
SAMPLE NO.	LOCATION / TYPE OF MATERIAL	RESULTS
16	Throughout / Ceiling Tile	1-3% Chry.
17	Throughout / Ceiling Tile	1-3% Chry.
18	Roof / Shingles	ND
19	Roof / Shingles	ND
20	Roof / Shingles	ND
21	Exterior / Window Glazing Compound	4-9% Chry.
22	Exterior / Window Glazing Compound	4-9% Chry.
23	Exterior / Window Glazing Compound	4-9% Chry.

CHRY. - CHRYSOTILE ASBESTOS AMO. - AMOSITE ASBESTOS ANTHO. - ANTHOPHYLLITE ASBESTOS
TRACE OR <1% - LESS THAN 1% ASBESTOS ND - NONE DETECTED

TABLE NO. 2 - PLM BULK SAMPLE ANALYSIS RESULTS TXDOT MCKINNEY - BLDG. 188060 2205 TX-5, MCKINNEY, TEXAS 75069		
SAMPLE NO.	**LOCATION / TYPE OF MATERIAL**	**RESULTS**
01	Roof / Shingles	ND
02	Roof / Shingles	ND
03	Roof / Shingles	ND
04	Front Office / Floor Tile (12x12) Mastic	ND 4-9%
05	Front Office / Floor Tile (12x12) Mastic	ND 4-9%
06	Front Office / Floor Tile (12x12) Mastic	ND 4-9%
07	Left Office / Floor Tile (9x9) Mastic	4-9% 4-9%
08	Left Office / Floor Tile (9x9) Mastic	4-9% 4-9%
09	Left Office / Floor Tile (9x9) Mastic	4-9% 4-9%
10	Front Office / Drywall Texture	ND
11	Right Office / Drywall Texture	4-9% Chry.
12	Left Office / Drywall Texture	4-9% Chry.
13	Front Office / Drywall Joint Compound	ND
14	Right Office / Drywall Joint Compound	ND

CHRY. - CHRYSOTILE ASBESTOS AMO. - AMOSITE ASBESTOS ANTHO. - ANTHOPHYLLITE ASBESTOS
TRACE OR <1% - LESS THAN 1% ASBESTOS ND - NONE DETECTED

TABLE NO. 2 - PLM BULK SAMPLE ANALYSIS RESULTS TXDOT MCKINNEY - BLDG. 188060 2205 TX-5, MCKINNEY, TEXAS 75069		
SAMPLE NO.	**LOCATION / TYPE OF MATERIAL**	**RESULTS**
15	Left Office / Drywall Joint Compound	ND
16	Front Office / Ceiling Tile	ND
17	Right Office / Ceiling Tile	ND
18	Right Office / Ceiling Tile	ND
19	Exterior / Window Glazing Compound	4-9% Chry.
20	Exterior / Window Glazing Compound	4-9% Chry.
21	Exterior / Window Glazing Compound	4-9% Chry.

CHRY. - CHRYSOTILE ASBESTOS AMO. - AMOSITE ASBESTOS ANTHO. - ANTHOPHYLLITE ASBESTOS
TRACE OR <1% - LESS THAN 1% ASBESTOS ND - NONE DETECTED

TABLE NO. 3 - PLM BULK SAMPLE ANALYSIS RESULTS TXDOT MCKINNEY - BLDG. 188064 2205 TX-5, MCKINNEY, TEXAS 75069		
SAMPLE NO.	**LOCATION / TYPE OF MATERIAL**	**RESULTS**
01	Exterior / Wall Texture	4-9% Chry.
02	Exterior / Wall Texture	4-9% Chry.
03	Exterior / Wall Texture	4-9% Chry.
04	Exterior / Window Glazing Compound	4-9% Chry.
05	Exterior / Window Glazing Compound	4-9% Chry.
06	Exterior / Window Glazing Compound	4-9% Chry.
07	Front Office / Floor Tile (12x12) Mastic	4-9% Chry. 4-9% Chry.
08	Bull Room / Floor Tile (12x12) Mastic	4-9% Chry. 4-9% Chry.
09	Hallway / Floor Tile (12x12) Mastic	4-9% Chry. 4-9% Chry.
10	Printer Area / Floor Tile (9x9) Mastic	ND ND
11	Printer Area / Floor Tile (9x9) Mastic	ND ND
12	Printer Area / Floor Tile (9x9) Mastic	ND ND
13	Office Adjacent to Warehouse / Floor Tile Mastic	ND ND

CHRY. - CHRYSOTILE ASBESTOS AMO. - AMOSITE ASBESTOS ANTHO. - ANTHOPHYLLITE ASBESTOS
TRACE OR <1% - LESS THAN 1% ASBESTOS ND - NONE DETECTED

TABLE NO. 3 - PLM BULK SAMPLE ANALYSIS RESULTS TXDOT MCKINNEY - BLDG. 188064 2205 TX-5, MCKINNEY, TEXAS 75069		
SAMPLE NO.	**LOCATION / TYPE OF MATERIAL**	**RESULTS**
14	Office Adjacent to Warehouse / Floor Tile Mastic	 ND ND
15	Office Adjacent to Warehouse / Floor Tile Mastic	 ND ND
16	Bull Room / Drywall Texture	 ND
17	Reception / Drywall Texture	 1-3% Chry.
18	Hallway of Reception / Drywall Texture	 4-9% Chry.
19	Office 1 Adjacent to Warehouse / Drywall Texture	 ND
20	Office 2 Adjacent to Warehouse Drywall Texture	 ND
21	Office 2 Adjacent to Warehouse Drywall Joint Compound	 ND
22	Office 1 Adjacent to Warehouse Drywall Joint Compound	 ND
23	Hallway Drywall Joint Compound	 ND
24	Reception / Ceiling Tile	 ND
25	Hallway / Ceiling Tile	 ND
26	Bull Room / Ceiling Tile	 ND

CHRY. - CHRYSOTILE ASBESTOS AMO. - AMOSITE ASBESTOS ANTHO. - ANTHOPHYLLITE ASBESTOS
TRACE OR <1% - LESS THAN 1% ASBESTOS ND - NONE DETECTED

TABLE NO. 4 - PLM BULK SAMPLE ANALYSIS RESULTS TXDOT MCKINNEY - BLDG. 188065 2205 TX-5, MCKINNEY, TEXAS 75069		
SAMPLE NO.	**LOCATION / TYPE OF MATERIAL**	**RESULTS**
01	Exterior / Wall Texture	ND
02	Exterior / Wall Texture	ND
03	Exterior / Wall Texture	ND
04	Office Ceiling / Drywall Texture	4-9% Chry.
05	Office Ceiling / Drywall Texture	4-9% Chry.
06	Office Ceiling / Drywall Texture	4-9% Chry.
07	Exterior / Window Glazing Compound	4-9% Chry.
08	Exterior / Window Glazing Compound	4-9% Chry.
09	Exterior / Window Glazing Compound	4-9% Chry.
10	Roof / Felt & Bitumin	ND
11	Roof / Felt & Bitumin	ND
12	Roof / Felt & Bitumin	ND

CHRY. - CHRYSOTILE ASBESTOS AMO. - AMOSITE ASBESTOS ANTHO. - ANTHOPHYLLITE ASBESTOS
TRACE OR <1% - LESS THAN 1% ASBESTOS ND - NONE DETECTED

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081402

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188059 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081402.01 20081402.01.A 1 Layer % of Total :100%	Texture Granular Homogeneous Tan/Yellow	No		Cellulose 1-10%	Binder Minrl Frags Paint
20081402.02 20081402.02.A 2 Layer % of Total :100%	Texture Granular Homogeneous Tan/Yellow	No		Cellulose 1-10%	Binder Minrl Frags Paint
20081402.03 20081402.03.A 3 Layer % of Total :100%	Texture Granular Homogeneous Tan/Yellow	No		Cellulose 1-10%	Binder Minrl Frags Paint
20081402.04 20081402.04.A 4 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%		Binder Minrl Frags Tar
20081402.04 20081402.04.B 4 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Brown	No		Cellulose 1-10%	Binder Carbonate Minrl Frags Vinyl
20081402.05 20081402.05.A 5 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%		Binder Minrl Frags Tar
20081402.05 20081402.05.B 5 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Brown	No		Cellulose 1-10%	Binder Carbonate Minrl Frags Vinyl

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081402

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188059 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081402.06 20081402.06.A 6 Layer % of Total :100%	Floor Tile & Glue Granular/Vinyl Homogeneous Gray/Tan	No		Cellulose 1-10%	Binder Carbonate Glue Vinyl
20081402.07 20081402.07.A 7 Layer % of Total :100%	Wall Texture Granular Homogeneous Tan/Yellow	Yes	Chrysotile 4-9%		Binder Carbonate Mica Paint
20081402.08 20081402.08.A 8 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/Yellow	No		Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081402.09 20081402.09.A 9 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/Yellow	No		Cellulose 11-50%	Binder Carbonate Mica Paint
20081402.10 20081402.10.A 10 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/Yellow	Yes	Chrysotile 4-9%	Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081402.11 20081402.11.A 11 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/Yellow	Yes	Chrysotile 4-9%	Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081402.12 20081402.12.A 12 Layer % of Total :100%	Wall Texture / J. Compound Granular Homogeneous Tan/Yellow	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081402

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188059 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081402.13 20081402.13.A 13 Layer % of Total :100%	Wall Texture / J. Compound Granular Homogeneous Tan/Yellow	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081402.14 20081402.14.A 14 Layer % of Total :100%	Wall Texture / J. Compound Granular Homogeneous Tan/Yellow	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081402.15 20081402.15.A 15 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/White	Yes	Chrysotile 1-3%	Cellulose 51-90%	Binder Glue Minrl Frags Paint
20081402.16 20081402.16.A 16 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/White	Yes	Chrysotile 1-3%	Cellulose 51-90%	Binder Glue Minrl Frags Paint
20081402.17 20081402.17.A 17 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/White	Yes	Chrysotile 1-3%	Cellulose 51-90%	Binder Glue Minrl Frags Paint
20081402.18 20081402.18.A 18 Layer % of Total :100%	Roof Shingle Fibrous/Granular/Tar Homogeneous Black/Brown	No		GlassFibers 11-50%	Binder Silica Tar
20081402.19 20081402.19.A 19 Layer % of Total :100%	Roof Shingle Fibrous/Granular/Tar Homogeneous Black/Brown	No		GlassFibers 11-50%	Binder Silica Tar

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081402

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188059 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081402.20 20081402.20.A 20 Layer % of Total :100%	Roof Shingle Fibrous/Granular/Tar Homogeneous Black/Brown	No		GlassFibers 11-50%	Binder Silica Tar
20081402.21 20081402.21.A 21 Layer % of Total :100%	Window Glazing Granular Homogeneous Brown/Gray	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081402.22 20081402.22.A 22 Layer % of Total :100%	Window Glazing Granular Homogeneous Brown/Gray	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081402.23 20081402.23.A 23 Layer % of Total :100%	Window Glazing Granular Homogeneous Brown/Gray	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081399

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188060 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/24/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081399.01 20081399.01.A 1 Layer % of Total :100%	Roof Shingle Fibrous/Granular/Tar Homogeneous Black/Brown	No		GlassFibers 11-50%	Binder Silica Tar
20081399.02 20081399.02.A 2 Layer % of Total :100%	Roof Shingle Fibrous/Granular/Tar Homogeneous Black/Brown	No		GlassFibers 11-50%	Binder Silica Tar
20081399.03 20081399.03.A 3 Layer % of Total :100%	Roof Shingle Fibrous/Granular/Tar Homogeneous Black/Brown	No		GlassFibers 11-50%	Binder Silica Tar
20081399.04 20081399.04.A 4 Layer % of Total :10%	Mastic Fibrous/Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%	Cellulose 1-10%	Binder Minrl Frags Tar
20081399.04 20081399.04.B 4 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Brown	No		Cellulose 1-10%	Binder Carbonate Minrl Frags Vinyl
20081399.05 20081399.05.A 5 Layer % of Total :10%	Mastic Fibrous/Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%	Cellulose 1-10%	Binder Minrl Frags Tar
20081399.05 20081399.05.B 5 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Brown	No		Cellulose 1-10%	Binder Carbonate Minrl Frags Vinyl

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081399

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188060 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/24/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081399.06 20081399.06.A 6 Layer % of Total :10%	Mastic Fibrous/Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%	Cellulose 1-10%	Binder Minrl Frags Tar
20081399.06 20081399.06.B 6 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Brown	No		Cellulose 1-10%	Binder Carbonate Minrl Frags Vinyl
20081399.07 20081399.07.A 7 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%		Binder Minrl Frags Tar
20081399.07 20081399.07.B 7 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Green	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Vinyl
20081399.08 20081399.08.A 8 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%		Binder Minrl Frags Tar
20081399.08 20081399.08.B 8 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Green	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Vinyl
20081399.09 20081399.09.A 9 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%		Binder Minrl Frags Tar

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081399

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188060 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/24/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081399.09 20081399.09.B 9 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Green	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Vinyl
20081399.10 20081399.10.A 10 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/White	No		Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081399.11 20081399.11.A 11 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/White	Yes	Chrysotile 4-9%	Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081399.12 20081399.12.A 12 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/White	Yes	Chrysotile 4-9%	Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081399.13 20081399.13.A 13 Layer % of Total :100%	Texture / J.Compound Granular Homogeneous White	No		Cellulose 1-10%	Binder Carbonate Mica Paint
20081399.14 20081399.14.A 14 Layer % of Total :100%	Texture / J.Compound Granular Homogeneous White	No		Cellulose 1-10%	Binder Carbonate Mica Paint
20081399.15 20081399.15.A 15 Layer % of Total :100%	Texture / J.Compound Granular Homogeneous White	No		Cellulose 1-10%	Binder Carbonate Mica Paint

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081399

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188060 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/24/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081399.16 20081399.16.A 16 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/White	No		Cellulose 51-90%	Binder Glue Minrl Frags Paint
20081399.17 20081399.17.A 17 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/White	No		Cellulose 51-90%	Binder Glue Minrl Frags Paint
20081399.18 20081399.18.A 18 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/White	No		Cellulose 51-90%	Binder Glue Minrl Frags Paint
20081399.19 20081399.19.A 19 Layer % of Total :100%	Window Glazing Granular Homogeneous Gray/Yellow	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081399.20 20081399.20.A 20 Layer % of Total :100%	Window Glazing Granular Homogeneous Gray/Yellow	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081399.21 20081399.21.A 21 Layer % of Total :100%	Window Glazing Granular Homogeneous Gray/Yellow	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081401

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188064 / 2205 TX-5 McKinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081401.01 20081401.01.A 1 Layer % of Total :100%	Texture Granular Homogeneous Gray/Yellow	Yes	Chrysotile 4-9%		Binder Minrl Frags Paint
20081401.02 20081401.02.A 2 Layer % of Total :100%	Texture Granular Homogeneous Gray/Yellow	Yes	Chrysotile 4-9%		Binder Minrl Frags Paint
20081401.03 20081401.03.A 3 Layer % of Total :100%	Texture Granular Homogeneous Gray/Yellow	Yes	Chrysotile 4-9%		Binder Minrl Frags Paint
20081401.04 20081401.04.A 4 Layer % of Total :100%	Window Glazing Granular Homogeneous Brown/Tan	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081401.05 20081401.05.A 5 Layer % of Total :100%	Window Glazing Granular Homogeneous Brown/Tan	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081401.06 20081401.06.A 6 Layer % of Total :100%	Window Glazing Granular Homogeneous Brown/Tan	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081401.07 20081401.07.A 7 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%		Binder Minrl Frags Tar

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081401

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188064 / 2205 TX-5 McKinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081401.07 20081401.07.B 7 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Tan	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Vinyl
20081401.08 20081401.08.A 8 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%		Binder Minrl Frags Tar
20081401.08 20081401.08.B 8 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Tan	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Vinyl
20081401.09 20081401.09.A 9 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	Yes	Chrysotile 4-9%		Binder Minrl Frags Tar
20081401.09 20081401.09.B 9 Layer % of Total :90%	Floor Tile Granular/Vinyl Homogeneous Tan	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Vinyl
20081401.10 20081401.10.A 10 Layer % of Total :100%	Floor Tile & Glue Granular/Vinyl Homogeneous Brown	No		Cellulose 1-10%	Binder Carbonate Glue Vinyl
20081401.11 20081401.11.A 11 Layer % of Total :100%	Floor Tile & Glue Granular/Vinyl Homogeneous Brown	No		Cellulose 1-10%	Binder Carbonate Glue Vinyl

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081401

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188064 / 2205 TX-5 McKinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081401.12 20081401.12.A 12 Layer % of Total :100%	Floor Tile & Glue Granular/Vinyl Homogeneous Brown	No		Cellulose 1-10%	Binder Carbonate Glue Vinyl
20081401.13 20081401.13.A 13 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	No		Cellulose 1-10%	Binder Minrl Frags Tar
20081401.13 20081401.13.B 13 Layer % of Total :90%	Floor Tile & Glue Granular/Vinyl Homogeneous Gray/Yellow	No		Cellulose 1-10%	Binder Carbonate Glue Vinyl
20081401.14 20081401.14.A 14 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	No		Cellulose 1-10%	Binder Minrl Frags Tar
20081401.14 20081401.14.B 14 Layer % of Total :90%	Floor Tile & Glue Granular/Vinyl Homogeneous Gray/Yellow	No		Cellulose 1-10%	Binder Carbonate Glue Vinyl
20081401.15 20081401.15.A 15 Layer % of Total :10%	Mastic Granular/Tar Homogeneous Black	No		Cellulose 1-10%	Binder Minrl Frags Tar
20081401.15 20081401.15.B 15 Layer % of Total :90%	Floor Tile & Glue Granular/Vinyl Homogeneous Gray/Yellow	No		Cellulose 1-10%	Binder Carbonate Glue Vinyl

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081401

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188064 / 2205 TX-5 McKinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081401.16 20081401.16.A 16 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/Yellow	No		Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081401.17 20081401.17.A 17 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/Yellow	Yes	Chrysotile 1-3%	Cellulose 11-50%	Binder Carbonate Mica Paint
20081401.18 20081401.18.A 18 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/Yellow	Yes	Chrysotile 4-9%	Cellulose 11-50%	Binder Carbonate Mica Paint
20081401.19 20081401.19.A 19 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/White	No		Cellulose 11-50%	Binder Carbonate Mica Paint
20081401.20 20081401.20.A 20 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/White	No		Cellulose 11-50%	Binder Carbonate Mica Paint
20081401.21 20081401.21.A 21 Layer % of Total :100%	Texture / J.Compound Fibrous/Granular Homogeneous White/Yellow	No		Cellulose 11-50%	Binder Carbonate Mica Paint
20081401.22 20081401.22.A 22 Layer % of Total :100%	Texture / J.Compound Fibrous/Granular Homogeneous White/Yellow	No		Cellulose 11-50%	Binder Carbonate Mica Paint

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081401

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188064 / 2205 TX-5 McKinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/25/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081401.23 20081401.23.A 23 Layer % of Total :100%	Texture / J.Compound Fibrous/Granular Homogeneous White/Yellow	No		Cellulose 11-50%	Binder Carbonate Mica Paint
20081401.24 20081401.24.A 24 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/Tan	No		Cellulose 51-90%	Binder Glue Minrl Frags Paint
20081401.25 20081401.25.A 25 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/Tan	No		Cellulose 51-90%	Binder Glue Minrl Frags Paint
20081401.26 20081401.26.A 26 Layer % of Total :100%	Ceiling Tile Fibrous/Granular Homogeneous Brown/Tan	No		Cellulose 51-90%	Binder Glue Minrl Frags Paint

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081400

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188065 / 2205 TX-5 Mckinney, TX

Date Received: 08/18/2020
Date Analyzed: 08/24/2020
Analyst Initial: HA

A&B Sample ID / Client Sample ID	Sample Description	Asbestos Detected	Asbestos Fibers	Other Fibers	Non - Fibrous Material
20081400.01 20081400.01.A 1 Layer % of Total :100%	Texture Granular Homogeneous Brown/White	No		Cellulose 1-10%	Binder Minrl Frags Paint
20081400.02 20081400.02.A 2 Layer % of Total :100%	Texture Granular Homogeneous Gray/White/Yellow	No		Cellulose 1-10%	Binder Minrl Frags Paint
20081400.03 20081400.03.A 3 Layer % of Total :100%	Texture Granular Homogeneous Silver/Yellow	No		Cellulose 1-10%	Binder Minrl Frags Paint
20081400.04 20081400.04.A 4 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/White	Yes	Chrysotile 4-9%	Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081400.05 20081400.05.A 5 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous White/Yellow	Yes	Chrysotile 4-9%	Cellulose 11-50%	Binder Carbonate Mica Paint
20081400.06 20081400.06.A 6 Layer % of Total :100%	Wall Texture Fibrous/Granular Homogeneous Brown/White	Yes	Chrysotile 4-9%	Cellulose 11-50%	Binder Carbonate Minrl Frags Paint
20081400.07 20081400.07.A 7 Layer % of Total :100%	Window Glazing Granular Homogeneous Gray/Red	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint

TEST REPORT FOR BULK ASBESTOS BY PLM

A&B Job ID 20081400

Date : 08/25/2020

Client Name: Garner & Associates, Inc.
Project Name: TXDOT Building 188065 / 2205 TX-5 Mckinney, TX

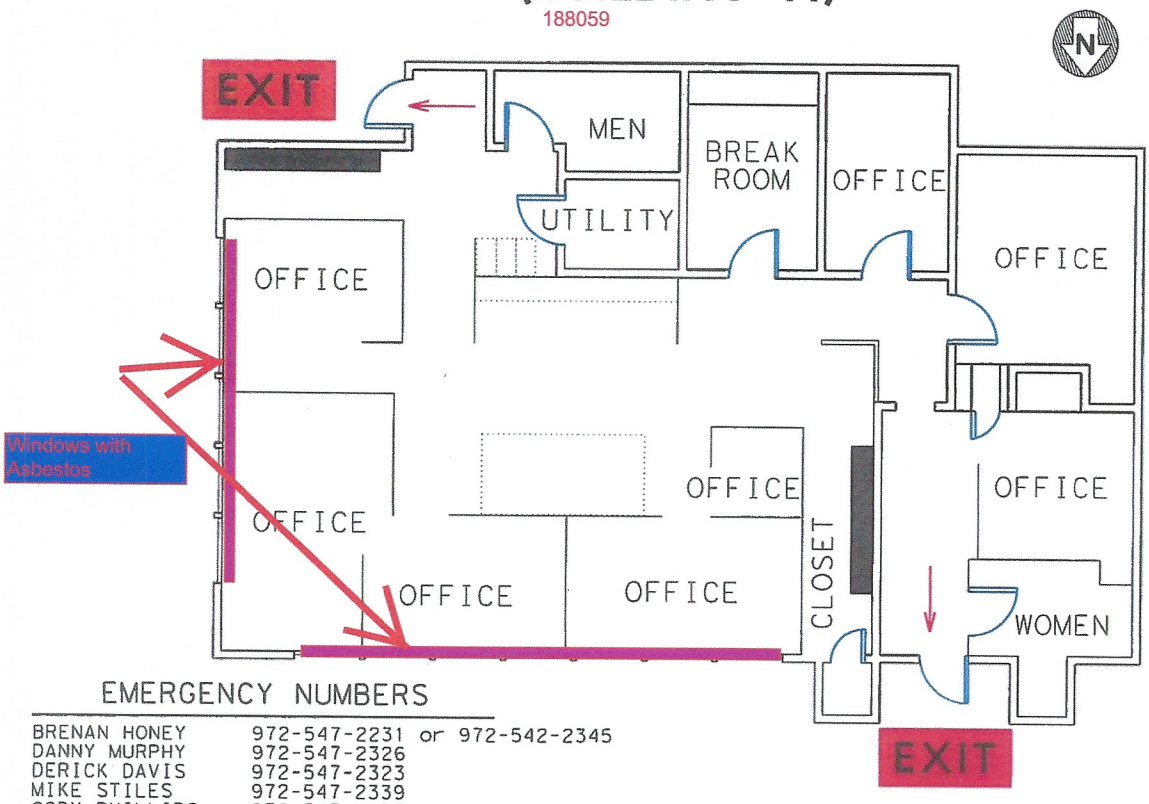
Date Received: 08/18/2020
Date Analyzed: 08/24/2020
Analyst Initial: HA

A&B Sample ID *Client Sample ID*	*Sample Description*	*Asbestos Detected*	*Asbestos Fibers*	*Other Fibers*	*Non - Fibrous Material*
20081400.08 20081400.08.A 8 Layer % of Total :100%	Window Glazing Granular Homogeneous Gray/Red	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081400.09 20081400.09.A 9 Layer % of Total :100%	Window Glazing Granular Homogeneous Gray/Red	Yes	Chrysotile 4-9%		Binder Carbonate Minrl Frags Paint
20081400.10 20081400.10.A 10 Layer % of Total :100%	Roofing Material Fibrous/Granular/Tar Homogeneous Black	No		GlassFibers 11-50%	Binder Minrl Frags Tar
20081400.11 20081400.11.A 11 Layer % of Total :100%	Roofing Material Fibrous/Granular/Tar Homogeneous Black	No		GlassFibers 11-50%	Binder Minrl Frags Tar
20081400.12 20081400.12.A 12 Layer % of Total :100%	Roofing Material Fibrous/Granular/Tar Homogeneous Black	No		GlassFibers 11-50%	Binder Minrl Frags Tar

DATE: @DATE@ FILE NAME: @FILE@

COLLIN COUNTY AREA OFFICE (BUILDING A)

188059



EMERGENCY NUMBERS

BRENAN HONEY	972-547-2231 or 972-542-2345
DANNY MURPHY	972-547-2326
DERICK DAVIS	972-547-2323
MIKE STILES	972-547-2339
CODY PHILLIPS	972-547-2235
FIRE DEPT.	911 OR 972-547-2700
POLICE DEPT.	911 OR 972-547-2700

EMERGENCY EXIT PLAN

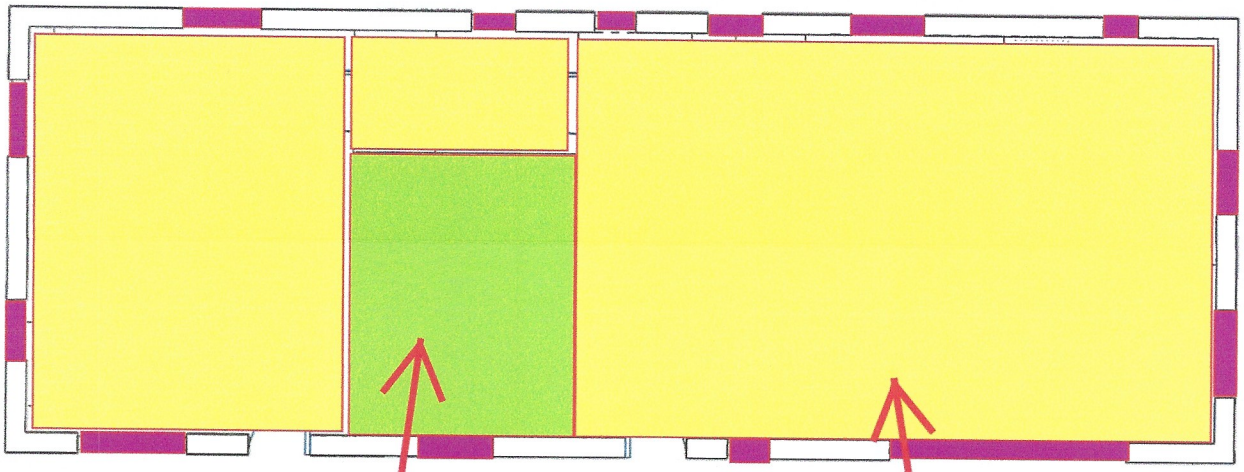
(EMERGENCY MEETINGS TO BE HELD IN THE MAINTENANCE, BUILDING C, BULL ROOM)

All the sheet rocks inside
All flooring materials (tiles and mastic)
All ceiling tiles
Windows as indicated above on the drawing

DATE: @DATE@ FILE NAME: @FILE@

COLLIN COUNTY AREA OFFICE LABORATORY (BUILDING B)

188060



EMERGENCY NUMBERS

BRENAN HONEY	972-547-2231 or 972-542-2345
DANNY MURPHY	972-547-2326
DERICK DAVIS	972-547-2323
MIKE STILES	972-547-2339
CODY PHILLIPS	972-547-2235
FIRE DEPT.	911 OR 972-547-2700
POLICE DEPT.	911 OR 972-547-2700

EMERGENCY EXIT PLAN

(EMERGENCY MEETINGS TO BE HELD IN THE MAINTENANCE, BUILDING C, BULL ROOM)

: Windows with asbestos glazing

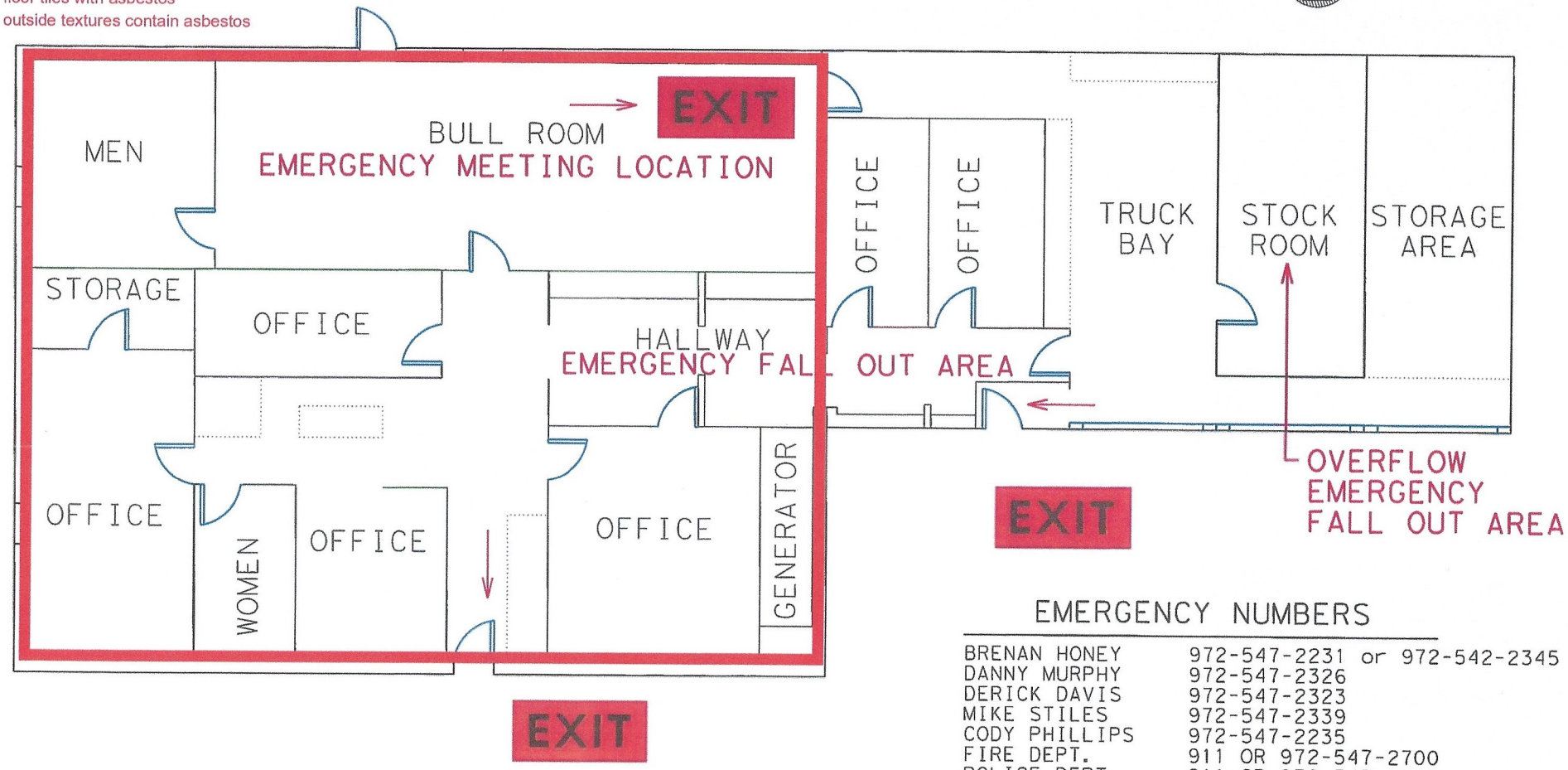
All drywalls inside the building

DATE: $DATE$ FILE NAME: $FILE$

COLLIN COUNTY AREA OFFICE
MAINTENANCE (BUILDING C)

188064

The old part of the building with asbestos sheet rocks inside the building.
All floor tiles with asbestos
All outside textures contain asbestos

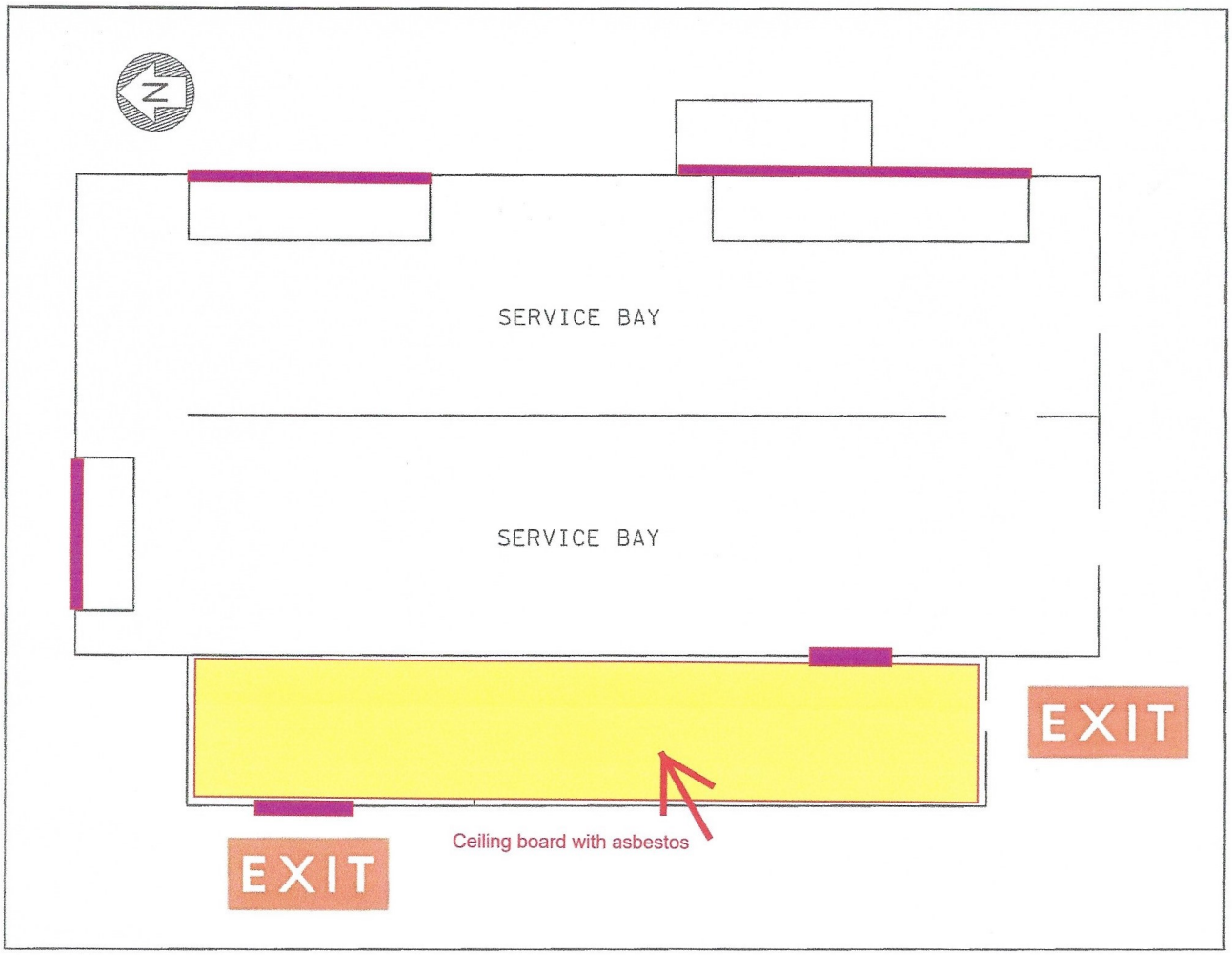


EMERGENCY NUMBERS

BRENAN HONEY	972-547-2231 or 972-542-2345
DANNY MURPHY	972-547-2326
DERICK DAVIS	972-547-2323
MIKE STILES	972-547-2339
CODY PHILLIPS	972-547-2235
FIRE DEPT.	911 OR 972-547-2700
POLICE DEPT.	911 OR 972-547-2700

EMERGENCY EXIT PLAN

(EMERGENCY MEETINGS TO BE HELD IN THE MAINTENANCE, BUILDING C, BULL ROOM)



Building D: 188065

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Texas Asbestos Health Protection Rules
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30 Texas Administrative Code 330
October 9, 1993

DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 GEOTECHNICAL DATA

A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.

B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.

C. A geotechnical investigation report for Project, Report No. **HG1710036.2.2** prepared by HVJ Associates, INC, dated November 11, 2020, is available for viewing as appended to this Document.

1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

D. Related Requirements:

1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
2. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to bidders.
3. Document 003126 "Existing Hazardous Material Information" for hazardous materials reports that are made available to bidders.

END OF DOCUMENT 003132

GEOTECHNICAL ENGINEERING REPORT
MCKINNEY AREA ENGINEER AND MAINTENANCE FACILITY
COLLIN COUNTY, TEXAS

SUBMITTED TO

JACOBS ENGINEERING GROUP, INC.

1999 BRYAN STREET, SUITE 1200

DALLAS, TEXAS 75201

BY

HVJ ASSOCIATES, INC.

HOUSTON, TEXAS

NOVEMBER 11, 2020

REPORT NO. HG1710036.2.2

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November 11, 2020

Mr. Steven Tremmel
Project Manager
Jacobs Engineering Group, Inc.
1999 Bryan St. Suite 1200
Dallas, TX 75231

Re: Geotechnical Investigation
McKinney Area Engineer and Maintenance Facility
Collin County, Texas
Owner: Texas Department of Transportation (TxDOT)
HVJ Report No. HG1710036.2.2

Dear Mr. Tremmel,

Submitted herein is the final report of our geotechnical investigation for the above referenced project. The study was conducted in general accordance with our proposal number HG1710036.2.2 and is subject to the limitations presented in this report. We appreciate the opportunity of working with you on this project. Please read the entire report and notify us if there are questions concerning this report or if we may be of further assistance.

Sincerely,

HVJ ASSOCIATES, INC.
Texas Firm Registration No. F-000646

Sharmi Vedantam, PE
Branch Manager

Vijay Kakara, EIT
Staff Engineer

The seal appearing on this document was authorized by Sharmi P. Vedantam, PE 100218 on November 11, 2020. Alteration of a sealed document without proper notification to the responsible engineer is an offense under the Texas Engineering Practice Act.

The following lists the pages which complete this report:

- Main Text – 13 pages
- Plates – 4 pages
- Appendix A– 7 pages
- Appendix B – 2 pages
- Appendix C – 7 pages
- Appendix D – 2 pages
- Appendix E– 4 pages

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PLATES

APPENDICES

1 EXECUTIVE SUMMARY

HVJ Associates, Inc. was retained by Jacobs to provide geotechnical services for the proposed construction of office facility for TxDOT in Collin County, Texas. Our scope of this study is to perform a geotechnical site investigation and provide foundation and pavement recommendations for the proposed office facility.

Based on the subsurface conditions revealed by the borings, the findings and recommendations of this report are summarized below:

1. A generalized summary of the soil profile encountered in the project area is presented in the table below. For detailed soil stratigraphy at each boring location, please refer to borings logs presented in Appendix A.

Table 1-1 **Generalized Soil Stratigraphy**

Approx. Depth (Elevation), Feet		**Material (USCS Classification)**
From	**To**	
Below Surface	8	Soft to hard cohesive soils (CL, CH)[1]
8	Boring termination	Hard to Very Hard Limestone[2]

Note: 1. A 1.5 to 2 feet thick cohesionless fill material was observed in borings B-8 and B-9 at the surface.
2. In Borings B-8 and B-10 limestone was not encountered.

2. Groundwater was not encountered during the drilling operations. However, it should be noted that groundwater conditions observed during drilling may not accurately reflect the groundwater conditions during construction, and therefore they should only be considered as approximate. Groundwater levels may fluctuate seasonally and in response to rainfall.

3. We have provided recommendations for the construction of shallow foundation with soil replacement and straight sided shafts in our report.

4. Pavement thickness recommendations for the employee and visiting parking areas are provided in Section 7 of the report.

Please note that this executive summary does not fully relate our findings and opinions. These findings and opinions are only presented through our full report.

2 INTRODUCTION

2.1 Project Description

HVJ Associates, Inc. was retained by Jacobs to provide geotechnical services for the proposed construction of office facility for TxDOT in Collin County, Texas. Our scope of this study is to perform a geotechnical site investigation and provide foundation and pavement recommendations for the proposed office facility. A site vicinity map is presented in Plate 1.

2.2 Geotechnical Investigation Program

The objectives of this study were to gather information on subsurface conditions at the project site and provide foundation recommendations. The objectives were accomplished by:

- Drilling 10 soil borings to a maximum depth of 35 feet (except 3 borings which were terminated at shallow depths due to the presence of contaminated soils) to determine soil stratigraphy and to obtain samples for laboratory testing;
- Performing laboratory tests to determine physical and engineering characteristics of the subsurface materials;
- Performing engineering analyses to develop design guidelines and recommendations.

Subsequent sections of this report contain descriptions of the field exploration, laboratory testing program and general site and subsurface conditions.

3 FIELD EXPLORATION

3.1 General

Subsurface conditions at the site were evaluated by drilling ten (10) borings to a maximum depth of 35 feet below the existing ground surface. Contaminated soils with strong gasoline smell were encountered at 10 to 15 feet depths in borings BP-5, BP-8 and BP-10. These borings are terminated at the depths where contaminated soils are encountered. Borehole locations were backfilled with soil cuttings and bentonite chips upon completion of drilling and patched at the surface. The boring layout is provided in Plate 2.

3.2 Sampling Methods

TxDOT cone penetrometer (TCP) tests were performed in all borings at approximately 5-foot intervals starting at a depth of five feet BGS, in accordance with Test Method TEX-132-E. The TxDOT cone test is used to determine the relative density or consistency of a subsurface material, and to develop bearing and skin friction resistance of the subsurface to aid in foundation design. The test consists of driving a 3-inch diameter cone with a 170-pound hammer, which is dropped from a distance of 24 inches. Following seating, the cone is driven for two consecutive 6-inch increments, and the blow counts for each increment are noted. The number of blows for each 6-inch increment and/or the amount of penetration for 50 blows was documented in the field. The drill rigs used on the project had an automatic hammer to minimize operator error while running the test.

Modified split spoons were conducted in non-cohesive and hard cohesive soils within the soil strata. The requirement that TCP be conducted caused the split spoons to be performed with a deviation from ASTM D 1586 – Penetration Test and Split-Barrel Sampling of Soils. The procedure performed in the field consisted of driving a standardized 1.50-inch inner diameter split-spoon

sampler into undisturbed soil with a 170-pound (as opposed to the standard 140-pound) hammer falling 24 inches (as opposed to the standard 30 inches). The split-spoon sampler was first seated 6 inches to penetrate any loose cuttings and was then driven an additional 12 inches with blows from the hammer. The number of hammer blows required to drive the sampler each 6-inch increment was recorded. The penetration resistance is defined as the number of hammer blows required to drive the sampler the final 12 inches and was used in the field to estimate the density of granular soils or the consistency of cohesive soils. In very dense material the split-spoon test was typically stopped after 50 blows from the hammer and the measurement was recorded as 50 blows per distance penetrated (e.g. 50 over 3 inches). These results are reported on the logs with an "SS" designation, they do not directly correspond to split spoon "N values".

Fine grained, cohesive soils encountered were sampled using a 3-inch outer diameter thin-walled tube, which was pushed into the soil in general accordance with ASTM standard D 1587- *Thin Walled Tube Sampling of Soils*. The samples were extruded in the field and a calibrated pocket penetrometer was used to obtain an estimate of the unconfined compressive strength of the sample.

Coring was performed when rock was encountered. The coring method employed consisted of a conventional double tube NX core barrel with an inside diameter of 2 inches and length of 5 feet and both compressed air and water was used to promote coring. The core samples were retrieved from the borehole and the percent recovery (REC) and the Rock Quality Designation (RQD) were recorded for each 5-foot run. The REC value was obtained by dividing the total length of core recovered by the total length of the core run. The RQD value was obtained by dividing the total length of sound core pieces with a minimum length of 4 inches by the total length of the core run. Each sample was removed from the sampler, carefully examined and then classified in the field. Suitable portions of each sample were sealed and packaged in core boxes for transportation to our laboratory.

Classification and field test results for both the thin-walled tube and split-spoon samples were recorded onto field logs, which included a visual description in accordance with ASTM D 2488 – *Visual Description and Identification of Soils*. After field documentation and logging was complete, the individual soil samples were either wrapped in plastic or placed in sealed containers to prevent loss of moisture and were transported to our laboratory for further examination and testing.

4 LABORATORY TESTING

Selected soil samples were tested in the laboratory to determine applicable physical and engineering properties. All tests were performed according to the relevant TxDOT/ASTM Standards. The laboratory program included moisture content, percent finer than No. 200 sieve, atterberg limits, unconfined compression, sulfate content test, CBR, standard proctor and consolidation.

The moisture content, percent finer than No. 200 sieve, liquid limit and plastic limit results were utilized to verify field classifications by the Unified Soils Classification System. The compression tests were performed to obtain the undrained shear strength of the soil. Consolidation tests were performed to estimate the settlement potential of the soil. The sulfate content test was conducted to estimate the sulfate attack potential of the soil. Soil-lime series tests were performed to estimate the minimum percent of lime needed to stabilize the onsite subgrade clays and to perform satisfactorily as a pavement subgrade. The type and number of tests performed for this investigation are summarized in Table 4-1.

Table 4-1– Type and Number of Laboratory Tests

Laboratory Test	Number of Tests
Moisture Content (Tex-103E)	30
% Passing #200 Sieve (Tex-111E)	19
Liquid Limit (Tex-104 E)	16
Plastic Limit (Tex-105 E)	16
Unconfined Compression (ASTM D2166)	24
Sulfate Content in Soil (Tex-620J)	3
California Bearing Ratio (CBR) Test (ASTM D1883)	1
Standard Proctor Test (ASTM D698)	1
Consolidation (ASTM D2435)	2

The laboratory test results for moisture content, atterberg limits, percent finer than No. 200 sieve, sulfate content and unconfined compression tests are shown on the boring logs presented in Appendix A. Standard Proctor and CBR test results are presented in Appendix C. Consolidation test results are shown in Appendix F

4.1 Atterberg Limits

Selected samples were tested to determine the Atterberg Limits in accordance with ASTM D4318 (TEX-104-E, and 105-E). The Atterberg Limit test is used to classify the soil using the Unified Soil Classification System (USCS). The Atterberg Limit test consists of two parts: a liquid limit test and a plastic limit test. The liquid limit equipment setup consists of a brass cup partially filled with soil which is grooved with a specialized grooving tool, and then dropped freely from a specified height to the rubber base below at a constant rate of 2 drops per second. The liquid limit test is performed on soil that has been sieved through the No. 40 sieve and brought to a moisture content that would close the ½-inch groove within 20 to 30 blows for two consecutive tests. The moisture content of the soil is then measured and recorded as the liquid limit. The second part of the test consists of a rolling a remolded sample between the tips of the fingers and a glass plate until transverse cracks appear at a rolled diameter of 1/8-inch. The moisture content of the rolled sample is taken and recorded as the plastic limit.

4.2 Percent Passing the No. 200 Sieve

Select soil samples were tested in accordance with ASTM D1140 (TEX-111-E) to determine the amount of material finer than the No. 200 sieve for use in classification. An oven dried sample of material is weighed then washed over a 75-μm (No. 200) sieve, allowing clay and other particles to be dispersed and removed from the soil. The retained material is oven dried then reweighed. The loss in mass resulting from the washing is calculated as mass percent of the original sample and is reported as the percentage of material finer than a No. 200 sieve.

4.3 Moisture Content

Moisture content testing was performed on select soil samples to determine the in situ state of moisture of the soil. A fresh sample was weighed before being placed in an oven with a controlled temperature of 230°F and dried back to a constant mass. Upon the drying and reweighing of the sample, the total mass of water lost was recorded. The ratio of the water loss to the dried mass is recorded as the moisture content. This test was performed in accordance with ASTM D2216 (TEX-103-E).

4.4 Sulfate Test

We performed sulfate tests (Tex-620J) on select soil samples to determine the sulfate content of subgrade soils. The test results are summarized in Table 4-3 and presented in Appendix D. Based on the test results, sulfate concentrations were less than 500 ppm-dry.

Table 4-2- Sulfate Test Results

Boring No.	Depth (feet)	Soil Description	Sulfate (ppm-dry)
BP-2	6-7.5	Fat Clay	440
BP-1	2-4	Fat Clay	106.6
BP-9	1-3	Fat Clay	20

4.5 Moisture Density Relationship

Standard Proctor tests are performed from the material obtained from the test pits. The results of standard Proctor tests are presented in the table below and are also presented in Appendix C.

Table 4-3 Standard Proctor Test Results

Location	Maximum Dry Density (lbf/ft^3)	Optimum Moisture Content %
Composite	94.8	21.7

4.6 CBR Value

Three California Bearing Ratio (CBR) tests were performed on the composite sample obtained from the project location. The results of the CBR tests are presented on the plates in Appendix C.

4.7 Consolidation Test

Consolidation tests were conducted on select soil samples obtained in the project area. The soils along the project alignment were found to be over consolidated. The OCR ratio of samples ranged from 5.33 to 7.54. Table 4-6 illustrates the consolidation parameters derived from the tests. The consolidation test results are presented in Appendix F.

Table 4-4- Consolidation Test Results

Boring No.	Depth (feet)	Soil Description	Precon-solidation Pressure (tsf)	OCR	Compression Index (c_c)	Recompression Index (c_r)
BP-4	8-9.5	Sandy Lean Clay	2.6	4.64	0.115	0.024
BP-7	6-8	Lean Clay w/ Sand	3.1	7.20	0.115	0.034

5 SITE CHARACTERIZATION

5.1 General Geology

The project is situated on Austin Chalk formation. It is an upper cretaceous geologic formation in the Gulf Coast region. It consists of calcareous clays and limestone and thickness ranges to 600 feet. A Geology Map is presented in Plate 3.

5.2 Soil Stratigraphy

Our interpretation of soil and groundwater conditions at the project site is based on information obtained at the boring locations only. Significant variations at areas not explored by the project borings may require reevaluation of our findings and conclusions.

Based on the subsurface conditions revealed by the borings, the findings and recommendations of this report are summarized below:

A generalized summary of the soil profile encountered in the project area is presented in the table below. For detailed soil stratigraphy at each boring location, please refer to borings logs presented in Appendix A.

Table 5-1 Generalized Soil Stratigraphy

Approx. Depth (Elevation), Feet		Material (USCS Classification)
From	To	
Below Surface	8	Soft to hard cohesive soils (CL, CH)[1]
8	Boring termination	Hard to Very Hard Limestone[2]

Notes: 1. About 1.5 to 2 feet thick cohesionless fill material was observed in borings B-8 and B-9 at the surface.
2. In Borings B-8 and B-10, limestone was not encountered.

5.3 Geologic Faulting

A review of surface faults was made from geologic literature and available in-house records. Based on our review, the project is not located near any documented geologic fault. We believe that faulting may not affect the project; however, it should be noted that unmapped faults that could impact the project may exist within the project area. A detailed fault assessment is not within the scope of this assessment.

5.4 Groundwater

Groundwater was not encountered during the drilling operations. However, it should be noted that groundwater conditions observed during drilling may not accurately reflect the groundwater conditions during construction, and therefore they should only be considered as approximate. Groundwater levels may fluctuate seasonally and in response to rainfall.

6 SHALLOW FOUNDATION RECOMMENDATIONS

6.1 General

We understand that as part of the project a new TxDOT Area office facility will be constructed. The information obtained from our soil borings BP-1 to BP-10 was used to provide the foundation and pavement recommendations for the proposed office facility.

6.2 Expansive Soil

One of the major design factors for lightly loaded structures in the general project area is the shrinking and swelling potential of fine-grained soils. The shrink/swell movements can be estimated through the use of the Plasticity Index (PI). Generally, the higher the PI of a material, the greater the potential for soil movements during moisture changes. Based on the soil conditions encountered in the borings drilled in this study, the soils at this site seem to have a very high expansion potential (Effective PI = 51). Potential Vertical Rise (PVR) values were estimated by the TEX 124-E method for the upper 7 feet of soils at the site, using the existing natural soil condition. The PVR represents the potential ability of a soil material at a specific density, moisture and loading condition to swell. It indicates the potential movement of the soils that may be realized if the soils become wet from a relatively dry condition. The PVR value is provided to demonstrate the relative severity of the swell potential of the clayey soils at the site; however, this value is not intended to be used directly as a design parameter. The actual amount of swell the slab may experience depends on many variables, such as the time of year the slab is poured, which are not known at the time of this study. The PVR values were estimated to be 2.90 inches for average and 3.67 inches for dry conditions. This swell potential is considered moderate to high.

6.3 Foundation Selection

Foundations for the proposed structure must satisfy two basic design criteria. First, the bearing pressure transmitted by the foundation should not exceed the allowable bearing pressure computed with an adequate factor of safety. Second, foundation movement due to soil volume change must be within desirable limits.

The subsurface soils at the top have a high expansion potential so we recommend the use of Shallow Foundations like strip footings with soil replacement of 4 feet or straight sided shafts with structural slab or soil replacement under the floor slab for this project.

6.4 Shallow Foundations

It should be noted that use of shallow foundations may be the cheapest foundation option, however the structural designer should carefully examine the structure and the foundation system against horizontal loads and differential settlements associated with the consolidation of the clay beneath the foundation. The footings should extend at least 4 feet below the existing ground surface. The allowable net total load bearing pressure and net dead plus sustained live load bearing pressure values at a depth of 4 feet below the existing grade are presented in the table below. These bearing pressures contain a factor of safety of 2 and 3, respectively.

Borings Used	Foundation Depth (ft)	Net Total Load Bearing Pressure (psf)	Net Dead plus Sustained Live Load Bearing Pressure (psf)
BP-8, 9 and 10	4	3,400	2,200

Positive drainage must be provided under the floor slab area at all times. We recommend placement of at least 12 inches of select fill above the existing grade to surcharge the subsurface soils and to provide positive drainage around the slab. Select fill criteria is discussed in Section 6.12.

6.5 Deep Foundation Recommendations

Due to the presence of expansive soils, the building can also be supported on straight sided shafts. The Wincore computer program that incorporates TxDOT standard procedures was used to compute the allowable unit and accumulative skin friction for drilled shafts. The following summarizes the procedures described in the Geotechnical Manual for drilled shaft foundation design.

- Drilled shafts are designed for both skin friction and end bearing.
- The allowable skin friction calculated for rock is limited to 3.25 tsf.
- The allowable skin friction capacity for the upper 10 feet below existing ground surface should be disregarded due to non-reliable friction transfer.
- The allowable skin friction capacity for fill material should be disregarded.
- If drilled shafts are to be founded in hard material that is overlain by soft strata, the skin friction contribution of the softer strata may be disregarded in design.

The following summarizes our adaptations to the procedures described in the Geotechnical Manual.

- Based on the subsurface stratigraphy encountered in the borings, the proposed shafts will be embedded into Limestone. The skin friction contribution from the overlain soils above the bedrock should be neglected since the bedrock encountered will not allow sufficient movement to mobilize skin friction in the overburden soils.
- TCP values were used to develop capacity curves.

6.6 Drilled Shaft Capacity

Allowable skin friction capacity and end bearing capacity for drilled shafts at boring locations were calculated using the Wincore program and presented in Appendix D. Soil Strength Analysis table printouts from the Wincore program are also presented in the appendix. The curves were developed for each boring location. The allowable values shown include a factor of safety of 2 according to the TxDOT Geotechnical Manual. The allowable skin friction values for rock include a factor of safety of 3 and the allowable end bearing values include a factor of safety of 2+ according to the TxDOT Geotechnical Manual. The maximum allowable drilled shaft service load should be determined in accordance with Chapter 5; Section 3 of the TxDOT Geotechnical Manual dated July, 2020.

Allowable compressive capacity due to skin friction may be calculated from the curves by reading the accumulative skin friction value corresponding to the tip penetration of the shaft and multiplying the value by the shaft perimeter. The allowable skin friction capacity for the upper 10 feet should be disregarded. An allowable end bearing capacity should be calculated by multiplying the shaft end

area by the allowable unit end bearing pressure. The allowable end bearing capacity should be added to the allowable skin friction capacity (adjusted to remove the appropriate disregard depth) to determine the total allowable drilled shaft compressive capacity. End bearing should be ignored for shaft diameters of 2 feet or less.

6.7 Lateral Capacity

Foundations often have to withstand some lateral loads due to wind in addition to axial loads. Lateral loads on drilled shafts will be countered by the mobilization of resistance in the surrounding soils as the shafts deflect. The lateral load capacity of the shaft, therefore, will depend on its relative stiffness, and the strength of the surrounding soils. A rational analysis of a problem involving lateral loading on a shaft must consider the interaction of the soil and the structure. Equilibrium of forces and compatibility of displacements throughout the total system are the two fundamental conditions that are to be satisfied in the analysis.

Lateral load analysis was beyond the scope of this study and should be performed using computer programs such as LPILE, etc. The input parameters for lateral load analysis are presented in Appendix E.

6.8 Drilled Shaft Construction Recommendations

Drilled shaft construction and installation should follow TxDOT Standard Specification Item 416, TxDOT Construction Bulletin C-9, and ACI 336.3R-14. Slurry displacement methods for drilled shaft construction are allowed under TxDOT Standard Specifications. Presented below are a few specific recommendations.

1. Cohesionless soils may be encountered in between borings during drilled shaft construction. The slurry displacement method or casing may be required to prevent the cave-in of surrounding material. Assessment of the need for casing and selection of appropriate augering equipment is the contractor's responsibility at the time of construction.

2. Drilled shaft excavations should be inspected for verticality and side sloughing. Verticality is specified at one inch in ten feet of the shaft length, and should be checked over the full depth of the drilled shaft.

3. Before placing concrete, the shaft bottom should be cleaned out with a drilling bucket in order to remove any sediments that may not be displaced by the concrete. The shaft bottoms should be cleaned with a "clean-out" bucket until rotation on the bottom without crowd (i.e. penetration under force) produces little spoil. Probing after clean-out is essential to verify the condition of the base of the shaft.

4. Concrete placement should be accomplished as directed in TxDOT Standard Specification Item 416.3.6.

5. A computation of the final concrete volume for each shaft should be made. Shafts taking an unreasonably high or low volume of concrete should be cored to check their integrity.

6. Casing which can be used to overcome caving because of the sands should be extracted slowly and smoothly with a vibratory hammer. The casing should always remain at least five feet below the level of the concrete during placement. Our analyses assume no casing will be

left in place. We should be informed if casing will be left in place so we may provide revised shaft capacity calculations.

7. Shaft excavations should not be made within two shaft diameters (edge to edge) of shafts that have been concreted within the last 24 hours or from open shaft excavation.

6.9 Floor Slab

Due to the presence of expansive clays, the most effective means to positively eliminate damage to a foundation slab due to shrinkage and swelling soils is to isolate the interior floor slab and grade beams from the soil by means of a structurally suspended floor system. For a structural slab, a minimum crawl space of 8 inches or larger is recommended to separate the subsurface clay soils from the grade beams. Positive drainage must be provided under the floor slab in the crawl space area at all times. However, a slab-on-grade floor with grade beams is both more common and cheaper than the structurally supported floor for lightly loaded building construction.

The interior floor slab may be supported on a slab-on-grade system provided that the recommendations to reduce the potential shrink-swell movements discussed in this section are followed. It should be noted that some risks are involved when a slab-on-grade floor is utilized. Some vertical movements of the floor slab are still possible during seasonal soil moisture variations. These movements could cause cracking of interior and exterior finishes, and operating problems such as doors which do not open and close freely. However, if the recommendations provided below are followed, we expect these movements to be less than 1 inch and not severe enough to cause serious damage to the slab.

To reduce the PVR to about one inch, we recommend placing the floor slab on a 5-feet thick pad prepared with properly compacted and moisture-conditioned structural fill. This may be achieved by replacing the top 4 feet of on-site soils with select fill or lime stabilized on-site soils, and surcharging the native soils with an additional one foot of compacted select fill. We estimate that about 6 to 8 percent hydrated lime by dry weight will be required to stabilize the on-site clay soils. Select fill criteria are presented in Section 6.12. We recommend that the pad extend horizontally at least 5 feet beyond the edge of the building. The exposed surface should be checked and tested if necessary by qualified geotechnical professionals to identify any soft or weak areas, and debris or undesirable materials, which should be removed and replaced with select fill or lime-stabilized on-site clays.

6.10 Foundation Inspection

We recommend that any fill placed beneath the floor slab be inspected by an accredited construction materials laboratory to determine compliance with the plasticity and compaction requirements. HVJ Associates, Inc. would be pleased to provide this service.

It is recommended that slab area and grade beam excavations be inspected by a person knowledgeable in slab foundation construction to verify that the bearing soils are competent and the bearing area is properly prepared prior to concrete placement.

6.11 Settlement

With the indicated bearing pressure and the use of a 5-foot thick pad prepared with properly compacted and moisture-conditioned structural fill underneath the slab, settlement is estimated to be less than one (1) inch. Differential settlement will result from variances in subsurface condition, loading conditions and construction procedures, such as cleanliness of the bearing area.

In case of drilled shafts movements will consist generally of elastic shortening of the shaft and soil deformation at the shaft tip. Drilled shaft settlement depends on several factors such as subsurface conditions, shaft size, and external loading. Typically, based on our experience, we expect that the settlement of drilled shafts will be less than ½ inch.

6.12 Subgrade Preparation and Structural Fill

The structure area should be stripped of all vegetation, topsoil and all deleterious materials. Stripped areas should be appropriately graded and shaped to provide positive drainage. Following site stripping, the exposed subgrade should be proof-rolled with heavy construction equipment to identify any weak areas. Any weak areas, if encountered, should be excavated to firm subgrade and be replaced with select fill. The exposed subgrade should be compacted to at least 95 percent of the materials maximum dry density determined according to ASTM D698 at a moisture content equal to (± 3) percentage points of the optimum value. Select fill required to raise the grade should consist of sandy lean clay or lean clay with a liquid limit less than 40 and a plasticity index between 7 and 20. Fill material should be placed in loose lifts not exceeding eight inches and should be compacted to 95 percent of the maximum dry density as determined by ASTM D698.

6.13 Drainage

Drainage around the structure perimeter is an important consideration in the performance of the structure. If an area of poor drainage is allowed to exist around the structure, the soils beneath the slab in that area have greater access to water. This may cause the soils in that area to exhibit higher shrink-swell movements compared to soils away from the area of poor drainage. Over time, these cycles of shrinking and swelling may cause damage to interior and exterior finishes, operating problems such as doors which do not open freely, and possible structural damage to the slab. The owner must take care to maintain good drainage over the life of the structure to reduce the chances of shrink-swell problems with a slab-on-grade floor.

6.14 Vegetation

Plants consume water to live and obtain this water through their root system. Landscaping which includes plantings close enough to the foundation such that the plantings consume significant moisture from the foundation soils are a common cause of foundation problems in areas with plastic soils. To avoid these problems, we recommend that landscaping be planned such that the plants are located at least one-half their mature width away from the edge of the foundation. Therefore, small shrubs should be located at least 2 feet, large shrubs at least 5 feet, and trees at least 20 feet from the edge of the foundation. For information on the mature widths of particular plants, we suggest consulting a landscape architect.

7 PARKING LOT RECOMMENDATIONS

7.1 General

We understand that the project will include construction of parking lot for the employees and visitors for the McKinney Area Office building.

7.2 Subgrade Strength

A California Bearing Ratio (CBR) test was performed on the composite subgrade material obtained from the borings in accordance with ASTM D1883. The method of compaction was in accordance with ASTM D698. According to the ASTM requirements, 95% of Maximum Dry Density (MDD) obtained from Standard Proctor is considered for CBR testing. The MDD for the composite sample was found to be 94.8 pcf and the CBR corresponding to 95% density is 3.1. The CBR test results are presented in Appendix C.

CBR was used to calculate the correlated subgrade resilient modulus using equation below resulting in 4,650 psi.

Subgrade Resilient Modulus = 1500 * CBR

The composite K-value required for pavement design was calculated to account for the underlying subbase and the potential loss of support arising from subbase erosion. Based on the underlying subbase, the effective modulus of subgrade reaction (k) was calculated to be 93 pci for 8" stabilized subgrade.

7.3 Pavement Sections

Based on the subgrade soils and the traffic data provided, the following pavement sections are recommended for the employee and visiting parking areas. Pavement design details are presented in Appendix G.

Parking Area	Rigid Pavement Section	Flexible Pavement Section
Employee Parking Area (Heavy Truck Traffic)	7" Concrete 6" Lime Stabilized Subgrade	3" Asphaltic Concrete 9" Crushed Limestone Base 6" Lime Stabilized Subgrade
Visitor Parking Area	6" Concrete 6" Lime Stabilized Subgrade	2" Asphaltic Concrete 9" Crushed Limestone Base 6" Lime Stabilized Subgrade

We have assumed the average vehicles per day based on the vehicle information provided to us by Jacobs. The design sections should be reviewed if more traffic loading is anticipated. We further recommend that an appropriate drainage system should be provided to drain the surface water as quickly as possible for the parking areas. Providing appropriate drainage system will reduce development of future pavement distress due to softened subgrade.

7.4 Reinforcement Steel Requirement

Longitudinal and transverse reinforcement steel is required to resist warping stresses in the rigid pavement section and to hold pavement cracks that develop tightly closed. In addition, reinforcement is required at pavement joints in order to prevent deflections across the joint.

Reinforcement can be designed as per Jointed Reinforced Concrete Pavement (JRCP) details (TxDOT Houston District) presented in Appendix G.

7.5 Preparation of Subgrade

Based on borings BP-1 to BP-10, we have cohesive soils at the top in the project area. At the time of construction the upper 6 inches of soil should be stabilized with 6 to 8% lime for estimation purposes. Please note that these are preliminary estimates; actual percentage of lime should be confirmed by conducting tests on the exposed subgrade material at the time of construction. Subgrade preparation for the proposed pavement sections should consist of clearing, stripping, proof-rolling and lime stabilization. We recommend the following procedures for subgrade preparation:

- Clear the proposed pavement area. Grubbing operations should be performed to remove root systems of any trees cleared within the limits of the proposed construction.

- Strip the surface soil to suitable depths. In areas where soft, compressible or loose clay soils are encountered, additional stripping may be required. Stripping should extend a minimum of two feet beyond the edge of the proposed pavement.

- Surfaces exposed after stripping should be proof-rolled with heavy equipment, such as a loaded dump truck, to identify any underlying zones or pockets of soft soils and to remove such weak materials. If backfill is required, the fill material should be prepared as described earlier in this report.

- Scarify the upper six inches of exposed surface as required, mix with lime and compact it to 95 percent of standard Proctor (ASTM D698).

8 LIMITATIONS

This investigation was performed for the exclusive use of Jacobs Engineering Group, Inc. for the proposed construction of McKinney Area Engineer and Maintenance Facility in Collin County, Texas. HVJ Associates, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common in the local area. HVJ Associates, Inc. makes no warranty, expressed or implied. The analyses and recommendations contained in this report are based on data obtained from subsurface exploration, laboratory testing, the project information provided to us and our experience with similar soil, rock and site conditions. The methods used indicate subsurface conditions only at the specific locations where samples were obtained, only at the time they were obtained, and only to the depths penetrated. Samples cannot be relied on to accurately reflect the strata variations that usually exist between sampling locations. Should any subsurface conditions other than those described in our boring logs be encountered, HVJ Associates, Inc. should be immediately notified so that further investigation and supplemental recommendations can be provided.

9 REFERENCES

1. Geotechnical Manual, Texas Department of Transportation, July 2020.

PLATES

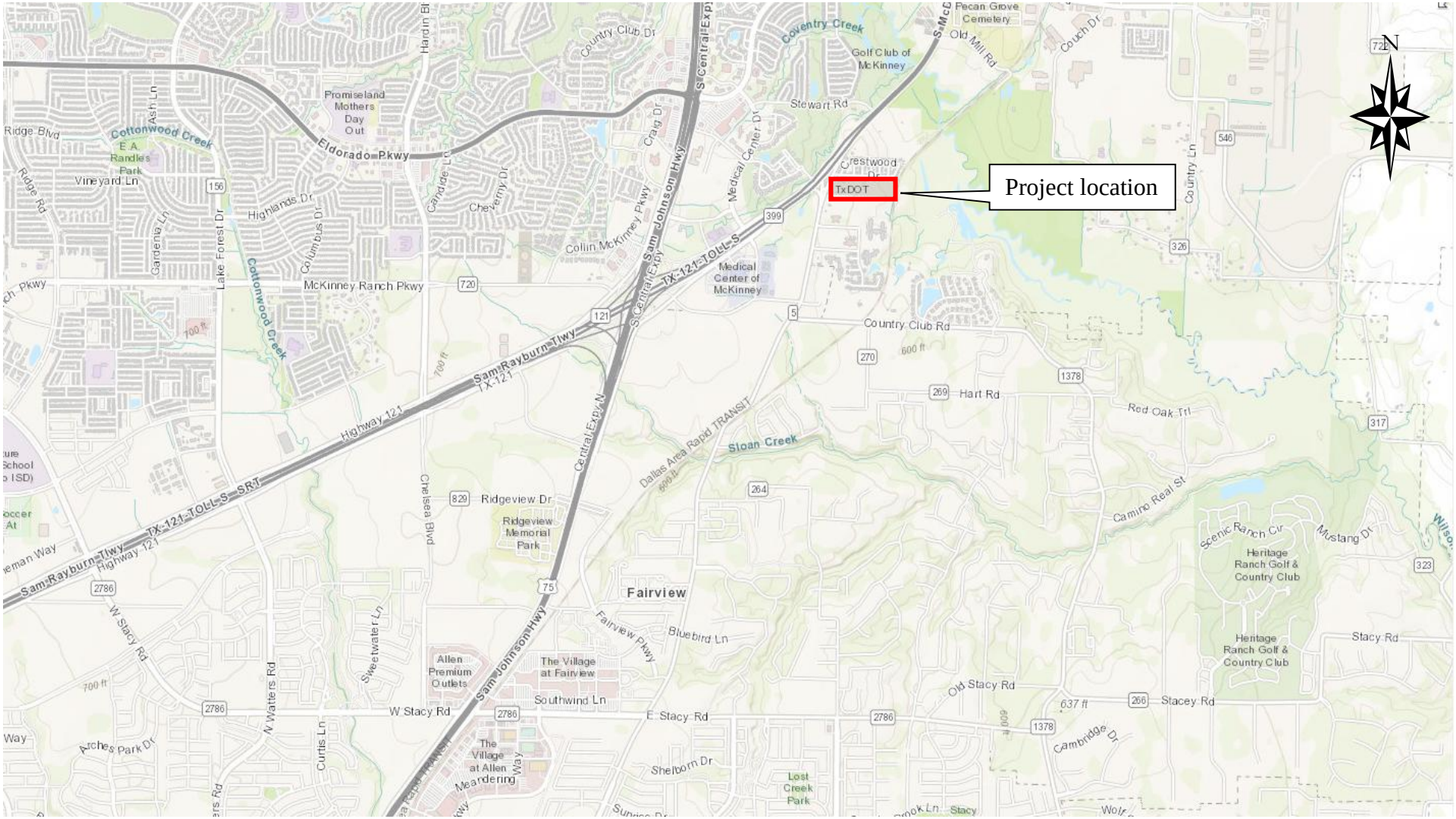

IMAGE SOURCE: ArcGIS

HVJ ASSOCIATES
6120 S. Dairy Ashford Road
Houston, Texas 77072-1010
281.933.7388 Ph
281.933.7293 Fax

DATE: 08/18/2020	APPROVED BY: SV	PREPARED BY: VK

SITE VICINITY MAP
McKinney Area Engineer and Maintenance Facility

PROJECT NO.:	DRAWING NO.:
HG1710036.2.2	PLATE 1

LEGEND:

APPROXIMATE BORING LOCATIONS

HVJ ASSOCIATES
6120 S. Dairy Ashford Road
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DATE: 08/18/2020	APPROVED BY: SV	PREPARED BY: VK

PLAN OF BORINGS
MCKINNEY AREA ENGINEER AND MAINTENANCE FACILITY

PROJECT NO.: HG1710036.2.2	DRAWING NO.: PLATE 2

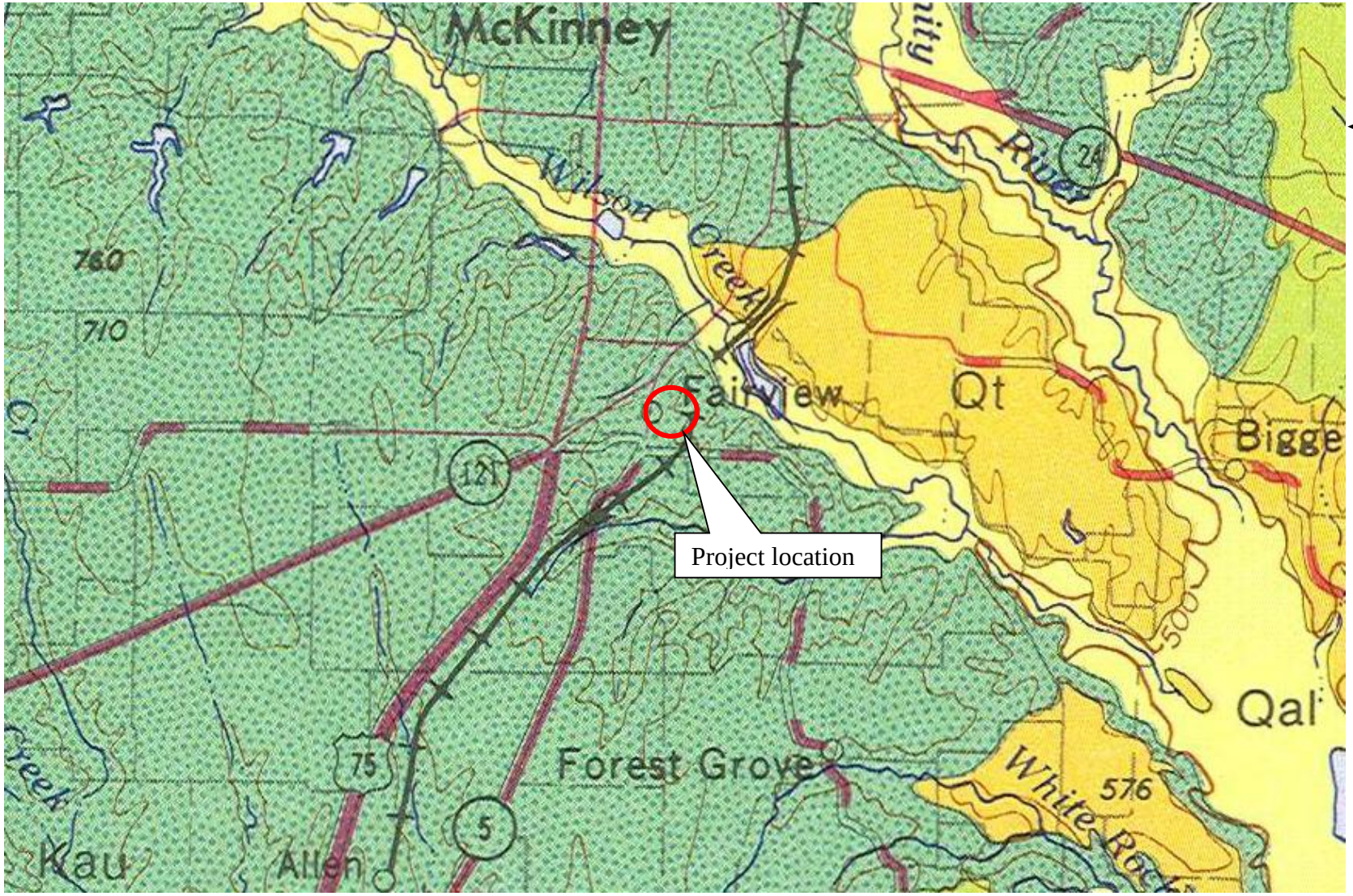

IMAGE SOURCE: USGS Pocket Texas Geology

Kau

<u>Austin Chalk</u> – It is an upper cretaceous geologic formation in the Gulf Coast region. Consists of calcareous clays and limestone, thickness ranges to 600 feet.

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GEOLOGIC MAP
McKinney Area Engineer and Maintenance Facility

PROJECT NO.: HG1710036.2.2	DRAWING NO.: PLATE 3

APPENDIX A

BORING LOGS AND KEY TO TERMS & SYMBOLS

DRILLING LOG

	County	Collin	Hole	BP- 1	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	06/29/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			CLAY, fat, moist, dark brown, with organics (CH)			32.7	80	52		%Pass #4 Sieve: 100.0 %Pass #40 Sieve: 97.1 %Pass #200 Sieve: 95.0 PP: 4.0
			CLAY, lean, hard, moist, light brown, with weathered limestone fragments (CL)	0	100.6	19.1			124	PP: 4.5 Sulfates: 107 ppm
5		50 (4) 50 (3)				13.9	44	24		%Pass #4 Sieve: 100.0 %Pass #40 Sieve: 94.8 %Pass #200 Sieve: 91.0 PP: 4.5
			LIMESTONE, highly weathered, hard to very hard, tan							
10		50 (0.75) 50 (0.25)	LIMESTONE, very hard, gray, fractured, slightly fossiliferous		1008.7	9.2			146.6	10ft-15ft: REC:80%, RQD:43%
15		50 (0.5) 50 (0.25)								15ft-20ft: REC:92%, RQD:57%
20		50 (0.5) 50 (0.25)			1018.5	10.7			144.5	20ft-25ft: REC:80%, RQD:80%
25		50 (0.25) 50 (0.25)								25ft-30ft: REC:100%, RQD:85%
30		50 (0.25) 50 (0.25)								
35										
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

DRILLING LOG

	County	Collin	Hole	BP- 2	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	07/2/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			CLAY, fat, sandy, stiff, moist, dark brown (CH)			23.6	72	45		%Pass #4 Sieve: 91.0 %Pass #40 Sieve: 90.0 %Pass #200 Sieve: 64.0 PP: 4.0
				0	17.2	40.1			111.4	PP: 2.5
			CLAY, fat, very stiff, moist, dark brown, trace limestone fragments (CH)			26.6	65	40		%Pass #4 Sieve: 99.0 %Pass #40 Sieve: 92.0 %Pass #200 Sieve: 89.0 PP: 3.0
5		23 (6) 25 (6)								
			LIMESTONE, highly weathered, hard to very hard, tan							
		50 (0.75) 50 (0.25)								
10			LIMESTONE, very hard, gray							10ft-15ft: REC:90%, RQD:90%
		50 (0.5) 50 (0.25)								
15					784.8	10.8			144.7	15ft-20ft: REC:100%, RQD:83%
		50 (0.25) 50 (0.25)								
20										20ft-25ft: REC:98%, RQD:95%
		50 (0.25) 50 (0.25)								
25										25ft-30ft: REC:100%, RQD:100%
		50 (0.25) 50 (0.25)			2559.1	9.8			146.2	
30										
35										
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

DRILLING LOG

	County	Collin	Hole	BP- 3	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	06/29/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			CLAY, lean w/ sand, stiff to very stiff, moist, light to dark brown, withtrace organics and weatheredlimestone fragments (CL)	0	15.6	30.2			114.7	%Pass #4 Sieve: 99.0 %Pass #40 Sieve: 88.0 %Pass #200 Sieve: 77.0 PP: 3.0
						18.4	44	26		%Pass #4 Sieve: 93.0 %Pass #40 Sieve: 87.0 %Pass #200 Sieve: 76.0 PP: 4.5 PP: 4.5
						12.7				
5		50 (2) 50 (1.75)	LIMESTONE, moderately weathered, soft to hard, gray, little fractured, trace fossil fragments							5ft-10ft: REC:75%, RQD:8%
10		50 (2) 50 (1)	LIMESTONE, trace fossils, hard to very hard, gray, little fractured							10ft-15ft: REC:80%, RQD:57%
15		50 (0.5) 50 (0.25)			1491.7	9.9			145.2	15ft-20ft: REC:97%, RQD:78%
20		50 (0.25) 50 (0.25)								20ft-25ft: REC:95%, RQD:88%
25		50 (0.25) 50 (0.25)			2084.9	10.6			145.5	25ft-30ft: REC:100%, RQD:65%
30		50 (0.25) 50 (0.25)								
35										
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

DRILLING LOG

	County	Collin	Hole	BP- 4	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	07/2/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			CLAY, fat, very soft to stiff, moist, dark brown, with trace subangular gravel and organic material (CH)	0	26.1	26			119	PP: 2.5
						26	68	48		%Pass #4 Sieve: 98 %Pass #40 Sieve: 93 %Pass #200 Sieve: 89
						20				PP: 3.0 PP: 2.5
5		3 (6) 3 (6)								
			CLAY, lean, sandy, very soft to very stiff, moist, tan, with trace weathered limestone fragments (CL)			14	39	23		%Pass #4 Sieve: 83 %Pass #40 Sieve: 67 %Pass #200 Sieve: 55 PP: 4.5
10		50 (1.5) 50 (1)	LIMESTONE, hard to very hard, gray		272.4	13			140.8	10ft-15ft: REC:77%, RQD:50%
15		50 (0.5) 50 (0.25)								15ft-20ft: REC:97%, RQD:93%
20		50 (0.25) 50 (0.25)			1053.3	12			142.6	20ft-25ft: REC:83%, RQD:77%
25		50 (0.25) 50 (0.25)								25ft-30ft: REC:100%, RQD:97%
30		50 (0.25) 50 (0.25)								30ft-35ft: REC:95%, RQD:92%
35		50 (0.25) 50 (0.25)			1523	11			145	
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates®**

DRILLING LOG

	County	Collin	Hole	BP- 5	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	07/1/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test: Lateral Press. (psi)	Triaxial Test: Deviator Stress (psi)	Properties: MC	Properties: LL	Properties: PI	Properties: Wet Den. (pcf)	Additional Remarks
			Pavement: 4" Asphalt							PP: 4.5
			CLAY, fat, stiff to hard, moist, light brown, with limestone fragments (CH)							PP: 4.5
										PP: 4.5
5		14 (6) 23 (6)								
										PP: 4.5
										PP: 4.5
10		50 (3) 50 (1.75)	-Boring terminated at 10 feet due to petroleum contamination.							
15										
20										
25										
30										
35										
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

DRILLING LOG

	County	Collin	Hole	BP- 6	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	06/30/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			8" Asphalt over 4" Base							PP: 4.5
			CLAY, fat, stiff, moist, brown, with trace calcareous nodules and some weathered limestone fragments (CH)			28.6	65	42		%Pass #4 Sieve: 100.0 %Pass #40 Sieve: 96.0 %Pass #200 Sieve: 92.0
						20.7				PP: 4.5
5		12 (6) 23 (6)								PP: 4.5
						14.5				%Pass #4 Sieve: 100.0 %Pass #40 Sieve: 97.0 %Pass #200 Sieve: 90.0
			LIMESTONE, highly weathered, hard, tan, trace iron stains							
10		50 (2) 50 (1)			513.9	10.1			145.4	
										10ft-15ft: REC:58%, RQD:38%
		50 (0.25) 50 (0.25)								
15			LIMESTONE, very hard, gray, slightly fossiliferous							
										15ft-20ft: REC:100%, RQD:100%
		50 (0.75) 50 (0.25)								
20					1410	10.8			144.7	
										20ft-25ft: REC:88%, RQD:87%
		50 (0.25) 50 (0.25)								
25										
										25ft-30ft: REC:100%, RQD:95%
		50 (0.25) 50 (0.25)								
30					1011	10.2			146.2	30ft-35ft: REC:68%, RQD:68%
		50 (0.25) 50 (0.25)								
35										
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

DRILLING LOG

	County	Collin	Hole	BP- 7	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	06/30/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			Pavement: 3" Asphalt							PP: 4.5
			CLAY, lean, with sand, soft to stiff, moist, dark brown, with trace weathered limestone fragments (CL)	0	27.5	25.9			110.9	PP: 4.5
						19	42	21		%Pass #4 Sieve: 94.0 %Pass #40 Sieve: 87.0 %Pass #200 Sieve: 79.0
5		8 (6) 10 (6)								PP: 4.5
										PP: 4.5
			LIMESTONE, highly weathered, hard to very hard, tan, trace iron stains							
10		50 (1.75) 50 (1)								10ft-15ft: REC:70%, RQD:38%
		50 (0.5) 50 (0.25)								
15			LIMESTONE, very hard, gray, slightly fossiliferous		262.9	12.3			141.1	
		50 (0.25) 50 (0.25)								15ft-20ft: REC:100%, RQD:97%
20										20ft-25ft: REC:100%, RQD:100%
		50 (0.25) 50 (0.25)			721.5	11.3			143.6	
25										25ft-30ft: REC:93%, RQD:93%
		50 (0.25) 50 (0.25)								
30										30ft-35ft: REC:97%, RQD:97%
		50 (0.25) 50 (0.25)								
35										
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

DRILLING LOG

	County	Collin	Hole	BP- 8	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	07/1/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			FILL, sand, clayey with gravel, loose, moist, black			15.2	26	8		%Pass #4 Sieve: 71.0 %Pass #40 Sieve: 46.0 %Pass #200 Sieve: 33.0 PP: 2.0
			CLAY, fat, stiff, moist, dark brown (CH)	0	21.4	39.8			107.1	
						32.6	72	53		%Pass #4 Sieve: 100.0 %Pass #40 Sieve: 98.0 %Pass #200 Sieve: 94.0 PP: 3.0
5		11 (6) 15 (6)								
			CLAY, lean, with sand, hard, moist, tan, with trace weathered limestone fragments, contamination below 8 feet (CL)			19.2	44	28		%Pass #4 Sieve: 98.0 %Pass #40 Sieve: 93.0 %Pass #200 Sieve: 80.0 PP: 4.5 PP: 4.5
10		50 (5) 50 (3)								
			-Boring terminated at 10 feet due to petroleum contamination.							
15										
20										
25										
30										
35										
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

DRILLING LOG

	County	Collin	Hole	BP- 9	District	Dallas
WinCore	Highway	N/A	Structure	Building	Date	07/1/2020
Version 3.1	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			Pavement: 2.5" Asphalt			11.1	30	9		%Pass #4 Sieve: 56.0 %Pass #40 Sieve: 20.0
			FILL, sand, with gravel, , moist, dark brown	0	21.6	31.8			112	%Pass #200 Sieve: 9.0 PP: 4.0
			CLAY, fat, soft to stiff, moist, dark brown (CH)			31.3	76	49		PP: 3.5 Sulfates < 100 ppm
5		5 (6) 9 (6)								%Pass #4 Sieve: 100.0 %Pass #40 Sieve: 98.0 %Pass #200 Sieve: 95.0
			SAND, moist, tan (SP)							PP: 3.0 PP: 4.5
						15.5				
10		50 (1) 50 (0.5)								%Pass #4 Sieve: 100.0 %Pass #40 Sieve: 97.0 %Pass #200 Sieve: 1.0
			LIMESTONE, very hard, gray, fossiliferous							10ft-15ft: REC:70%, RQD:12%
15		50 (0.5) 50 (0.25)			1762.7	10.4			145.3	
										15ft-20ft: REC:100%, RQD:97%
20		50 (0.25) 50 (0.25)								
										20ft-25ft: REC:80%, RQD:75%
25		50 (0.75) 50 (0.25)			1623.9	10			147.5	
										25ft-30ft: REC:100%, RQD:100%
30		50 (0.25) 50 (0.25)								
										30ft-35ft: REC:100%, RQD:95%
35		50 (0.25) 50 (0.25)								
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

DRILLING LOG

WinCore Version 3.1	County	Collin	Hole	BP-10	District	Dallas
	Highway	N/A	Structure	Building	Date	06/30/2020
	CSJ	N/A	Station	N/A	Grnd. Elev.	N/A
			Offset	N/A	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			6" Asphalt							
			CLAY, fat, stiff to very hard, moist, dark brown, with weathered limestone fragments, some gravel, contaminated below 15 feet (CH)			40.1	86	55		PP: 4.5
										%Pass #4 Sieve: 100.0
										%Pass #40 Sieve: 99.0
				0	26.4	27			118.5	%Pass #200 Sieve: 96.0
										PP: 2.5
5		22 (6) 30 (6)								PP: 2.5
						23.6	69	47		
										%Pass #4 Sieve: 100.0
										%Pass #40 Sieve: 99.0
				0	7.8	12.7			124.3	%Pass #200 Sieve: 92.0
10		14 (6) 15 (6)								PP: 4.5
										PP: 4.5
		50 (0.75) 50 (0.5)								PP: 4.5
15			Boring terminated at 15 feet due to petroleum contamination.							
20										
25										
30										
35										
40										

Remarks: PP: Pocket Penetrometer readings are in tsf. Groundwater was not encountered during drilling operations. Elevation data not available.

The ground water elevation was not determined during the course of this boring.

Driller: Total Depth **Logger: AH** **Organization: HVJ Associates, Inc.**

SOIL SYMBOLS

Soil Types

SOIL GRAIN SIZE

Classification	Particle Size	Particle Size or Sieve No. (U.S. Standard)
Clay	< 0.005 mm	< 0.002 mm
Silt	0.005 - 0.074 mm	0.002 mm - #200 sieve
Sand	0.074 - 4.75 mm	#200 sieve - #4 sieve
Gravel	4.75 - 75 mm	#4 sieve - 3 in.
Cobble	75 - 200 mm	3 in. - 8 in.
Boulder	> 200 mm	> 8 in.

DENSITY OF COHESIONLESS SOILS

Density of Cohesionless Soil	TxDOT Cone Penetrometer Blow Count
Very Loose	0 - 8
Loose	8 - 20
Slightly Compact	20 - 40
Compact	40 - 80
Dense	80 - 100 (5")
Very Dense	100 (5") - 100 (0")

CONSISTENCY OF COHESIVE SOILS

Consistency	Deviator Stress Strength (psi)	TxDOT Cone Penetrometer Blow Count
Very Soft	0 - 3.48	0 - 8
Soft	3.48 - 13.9	8 - 20
Stiff	13.9 - 27.8	20 - 40
Very Stiff	27.8 - 55.6	40 - 80
Hard	> 55.6	80 - 100 (5")
Very Hard		100 (5") - 100 (0")

TxDOT Cone Penetrometer

Blows required to penetrate each of two consecutive 6-inch increments
If more than 50 blows are required, driving is discontinued and penetration at 50 blows is noted

TERMS DESCRIBING SOIL STRUCTURE

Slickensided	Fracture planes appear polished or glossy, sometimes striated
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Inclusion	Small pockets of different soils, such as small lenses of sand scattered through a mass of clay
Parting	Inclusion less than 1/4 inch thick extending through the sample
Seam	Inclusion 1/4 inch to 3 inches thick extending through the sample
Layer	Inclusion greater than 3 inches thick extending through the sample
Laminated	Soil sample composed of alternating partings of different soil type
Stratified	Soil sample composed of alternating seams or layers of different soil type
Intermixed	Soil sample composed of pockets of different soil type and laminated or stratified structure is not evident
Calcareous	Having appreciable quantities of calcium carbonate
Ferrous	Having appreciable quantities of iron
Nodule	A small mass of irregular shape

HVJ ASSOCIATES
6120 S. Dairy Ashford Road
Houston, Texas 77072-1010
281.933.7388 Ph
281.933.7293 Fax

KEY TO TERMS AND SYMBOLS USED ON BORING LOGS

McKinney Area Engineer and Maintenance Facility

PROJECT NO.: HG1710036.2.2

DRAWING NO.: PLATE A-2

APPENDIX B

LAB SUMMARY

Company Name: HVJ Associates, Inc
Project: Txdot Engineering And Maintenance Facility
Location: Collin County, Texas
Project Number: HG1710036.2.2

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	% Passing #200 Sieve	Moisture Content (%)	Shear Strength (UC) (psi)	Pocket Pen (tsf)	Wet Density (pcf)
BP- 1	0	80	28	52	95	33		4.0	
BP- 1	2					19	50	4.5	124.0
BP- 1	4	44	20	24	91	14		4.5	
BP- 1	12						1009		146.6
BP- 1	21						1019		144.5
BP- 2	0	72	27	45	64	24		4.0	
BP- 2	1					40	9	2.5	111.4
BP- 2	3	65	25	40	89	27		3.0	
BP- 2	15						785		144.7
BP- 2	29						2559		146.2
BP- 3	0				77	30	8	3.0	114.7
BP- 3	2	44	18	26	76	18		4.5	
BP- 3	4					13		4.5	
BP- 3	15						1492		145.2
BP- 3	27						2085		145.5
BP- 4	0					25	13	2.5	119.0
BP- 4	1	68	20	48	89	26		3.0	
BP- 4	3					20		2.5	
BP- 4	6	39	16	23	55	14		4.5	
BP- 4	12						272		140.8
BP- 4	22						1053		142.6
BP- 4	34						1523		145.0
BP- 5	0							4.5	
BP- 5	1							4.5	
BP- 5	3							4.5	
BP- 5	6							4.5	
BP- 5	8							4.5	
BP- 6	0							4.5	
BP- 6	1	65	23	42	92	29		4.5	
BP- 6	3					21		4.5	
BP- 6	6				90	15			
BP- 6	11						514		145.4
BP- 6	20						1410		144.7
BP- 6	33						1011		146.2

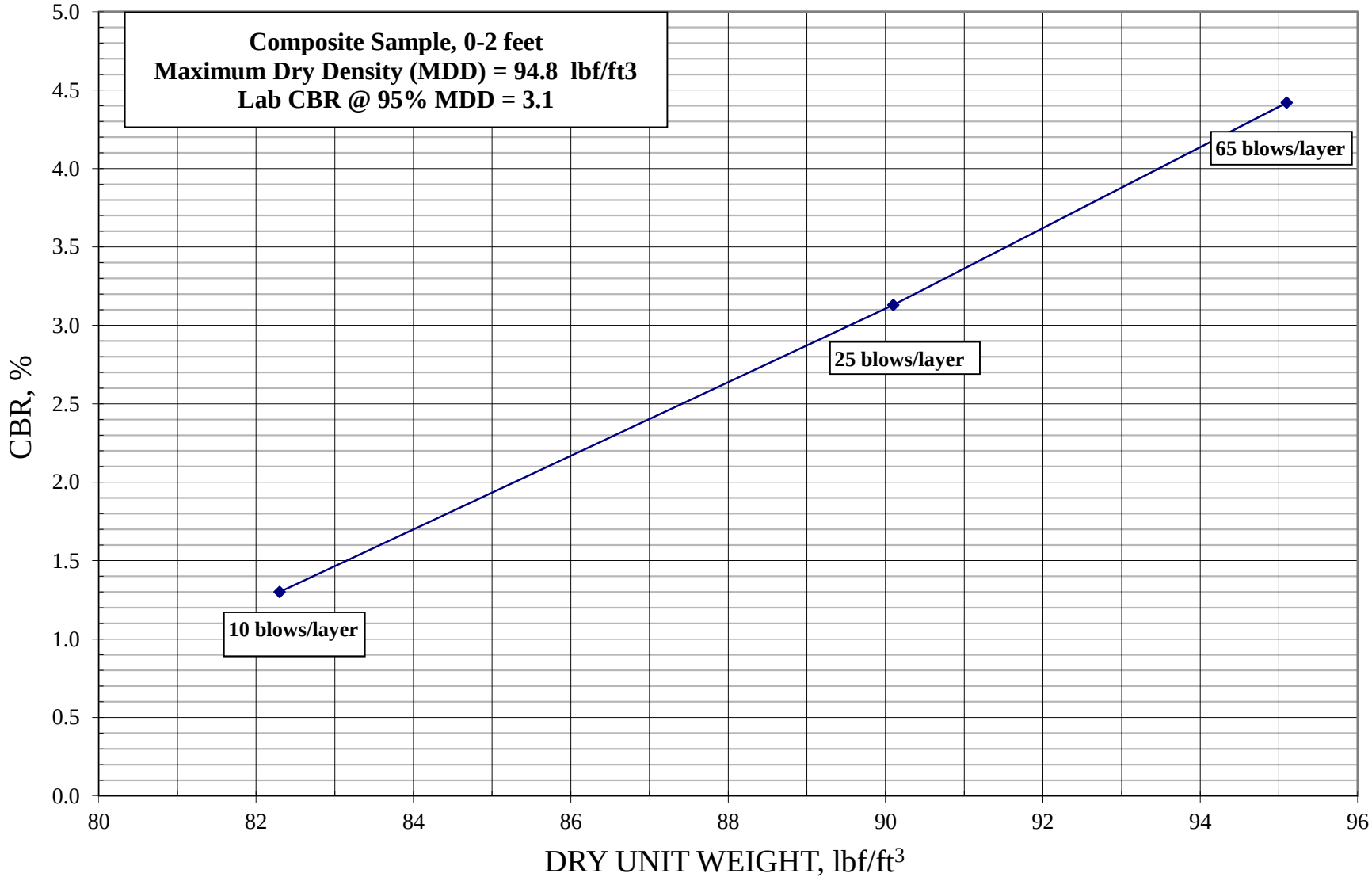
Company Name: HVJ Associates, Inc
Project: Txdot Engineering And Maintenance Facility
Location: Collin County, Texas
Project Number: HG1710036.2.2

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	% Passing #200 Sieve	Moisture Content (%)	Shear Strength (UC) (psi)	Pocket Pen (tsf)	Wet Density (pcf)
BP- 7	0							4.5	
BP- 7	1					26	14	4.5	110.9
BP- 7	3	42	21	21	79	19		4.5	
BP- 7	6							4.5	
BP- 7	16								141.1
BP- 7	25						722		143.6
BP- 8	0	26	18	8	33	15			
BP- 8	2					40	11	2.0	107.1
BP- 8	3	72	19	53	94	33		3.0	
BP- 8	6	44	16	28	80	19		4.5	
BP- 8	8							4.5	
BP- 9	0	30	21	9	9	11			
BP- 9	0							4.0	
BP- 9	1					32	11	3.5	112.0
BP- 9	3	76	27	49	95	31		3.0	
BP- 9	6							4.5	
BP- 9	8				1	16			
BP- 9	16						1763		145.3
BP- 9	27						1624		147.5
BP-10	1							4.5	
BP-10	1	86	31	55	96	40		2.5	
BP-10	3					27	13	2.5	118.5
BP-10	6	69	22	47	92	24		4.5	
BP-10	8					13	4	4.5	124.3
BP-10	13							4.5	
Total		16	16	16	19	30	24	39	25

APPENDIX C

STANDARD PROCTOR AND CBR TEST RESULTS

CALIFORNIA BEARING RATIO TEST RESULT



8701 John Carpenter Freeway, Suite 250
Dallas, TX 75247
214.678.0227 Ph
214.678.0228 Fax
www.hvj.com Registration No. F-017942

Proctor Report

Report No: PTR:DAL-W9648-S1

Client: JACOBS ENGINEERING GROUP, INC. **CC:**

Project: MCKINNEY AREA ENGINEER AND MAINTENANCE FACILITY

Project No.: HG1710036.2.2

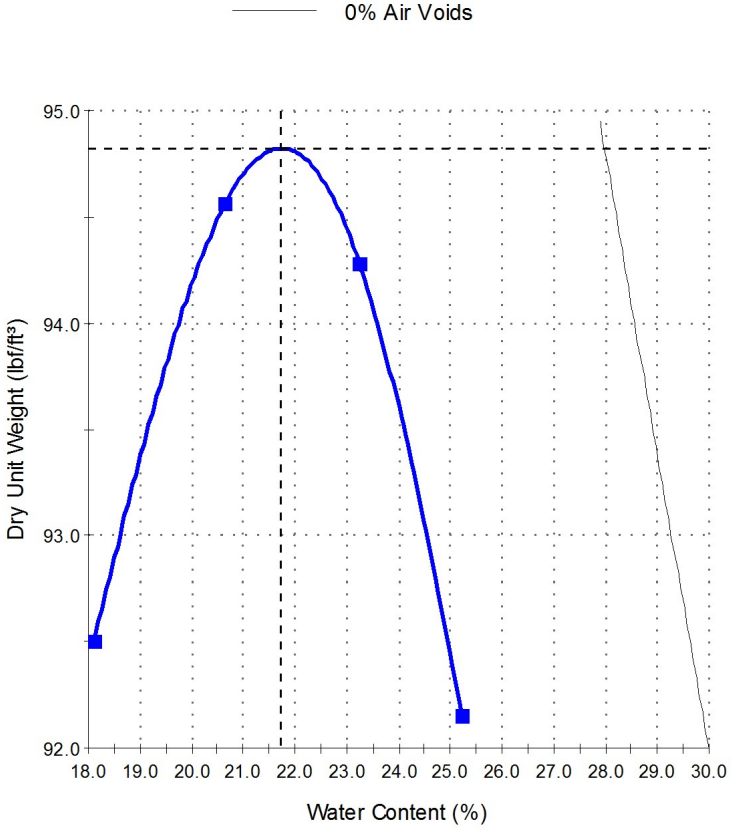
Date of Issue: 8/21/2020

Sample Details

Sample ID: Composite Sample (0'-2') **Date Sampled:** 7/28/2020

Tested By: **Date Tested:**

Dry Unit Weight - Water Content Relationship



Test Results

ASTM D 698

Maximum Dry Unit Weight (lbf/ft³):	**94.8**
Optimum Water Content (%):	**21.7**
Method:	B
Preparation Method:	Moist
Specific Gravity (Fines):	2.65
Retained Sieve 3/8" (9.5mm) (%):	0
Passing Sieve 3/8" (9.5mm) (%):	100
Tested By:	
Date Tested:	

Comments

Time Left Lab: **Time Arrived Site:** **Time Left Site:** **Time Arrived Lab:** **Lunch Hours:** **Total Hours:**

CBR (CALIFORNIA BEARING RATIO) OF LABORATORY COMPACTED SOILS ASTM D-1883

Project: McKinney Area Engineer and Maintenance Facility

Sample Location: Composite, 0-2 feet

Method of Compaction: ☒ ASTM D698
☐ ASTM D1557

Sample Condition: ☒ soaked ☐ unsoaked

No. of Blows:	**10**	**25**	**65**
Dry Density Before Soaking (pcf):	87.7	94.6	97.6
Dry Density After Soaking (pcf):	82.3	90.1	95.1
Moisture Content:			
Before Compaction (%):	23.0	23.4	21.8
Top 1-inch Layer After Soaking (%):	38.9	31.58	26.0
Swell (%):	1.21	1.89	1.04
Bearing Ratio (%): (☒ soaked ☐ unsoaked)	1.30	3.13	4.42

Surcharge: 10 lbs.

APPENDIX D

DRILLED SHAFT CAPACITY CURVES

SOIL STRENGTH ANALYSIS

WinCore Version 3.1

County	**Collin**	**Hole**	**BP- 1**	**District**	**Dallas**
Highway	**N/A**	**Structure**	**Office Building**	**Date**	**06/29/2020**
Control	**N/A**	**Station**	**N/A**	**Grnd. Elev.**	**0.00 ft**
		Offset	**N/A**	**GW Elev.**	**N/A**

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet) From	To	Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
1	0.0	-2.5	CH	50	0	0.00	0.00
2	-2.5	-7.0	CL	60	171	0.96	4.34
3	-7.0	-10.0	OTHER	60	0	0.00	4.34
4	-10.0	-13.0	OTHER	80	1200	3.25	14.09
4	-13.0	-18.0	OTHER	80	1600	3.25	30.34
4	-18.0	-23.0	OTHER	80	1600	3.25	46.59
4	-23.0	-27.5	OTHER	80	2400	3.25	61.21
4	-27.5	-30.0	OTHER	80	2400	3.25	69.34

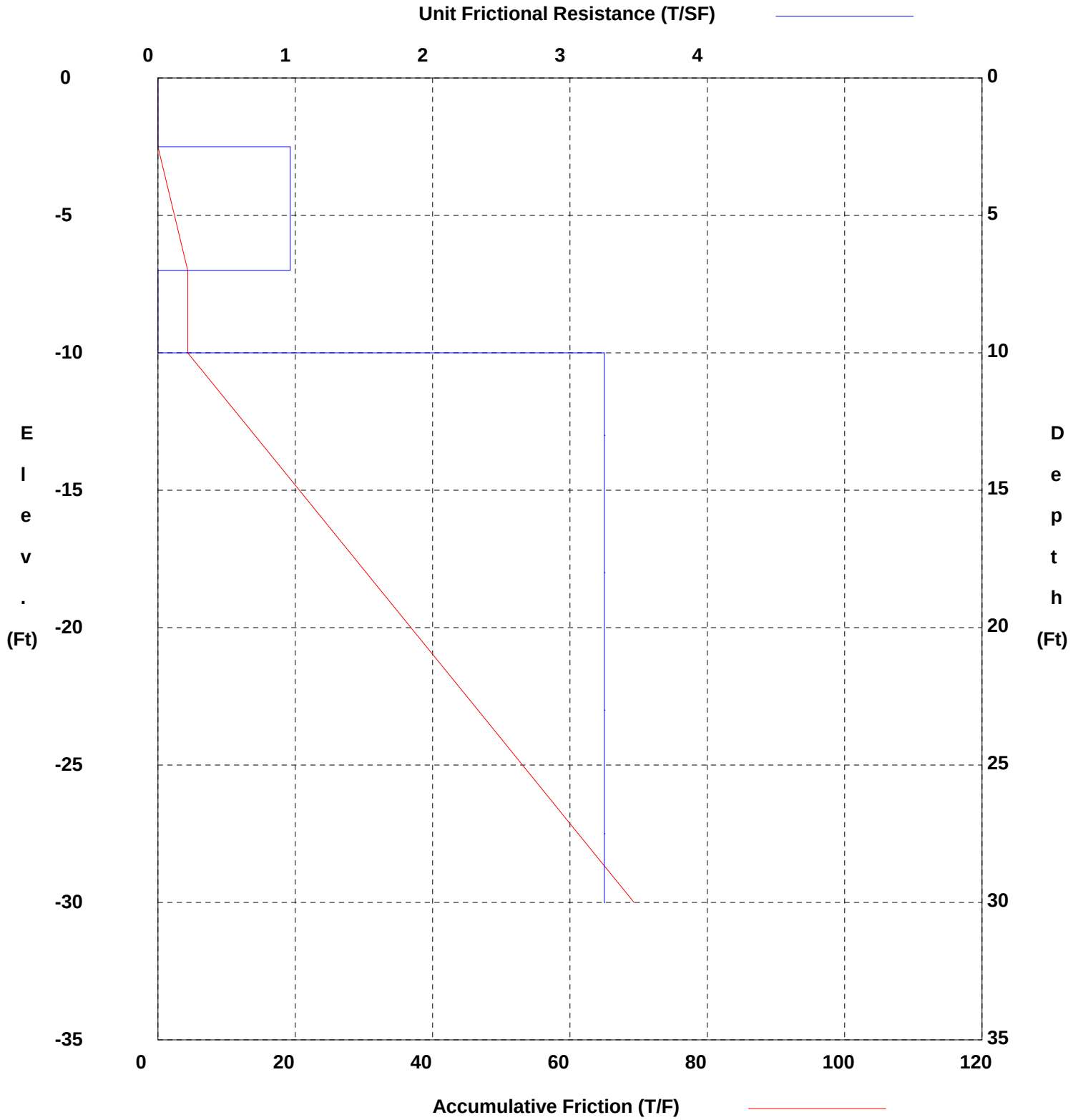
SKIN FRICTION DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 1	District	Dallas
Highway	N/A	Structure	Office Building	Date	06/29/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Drilled Shaft Design: Soil Reduction Factor = 0.7

TCP Friction Values Used



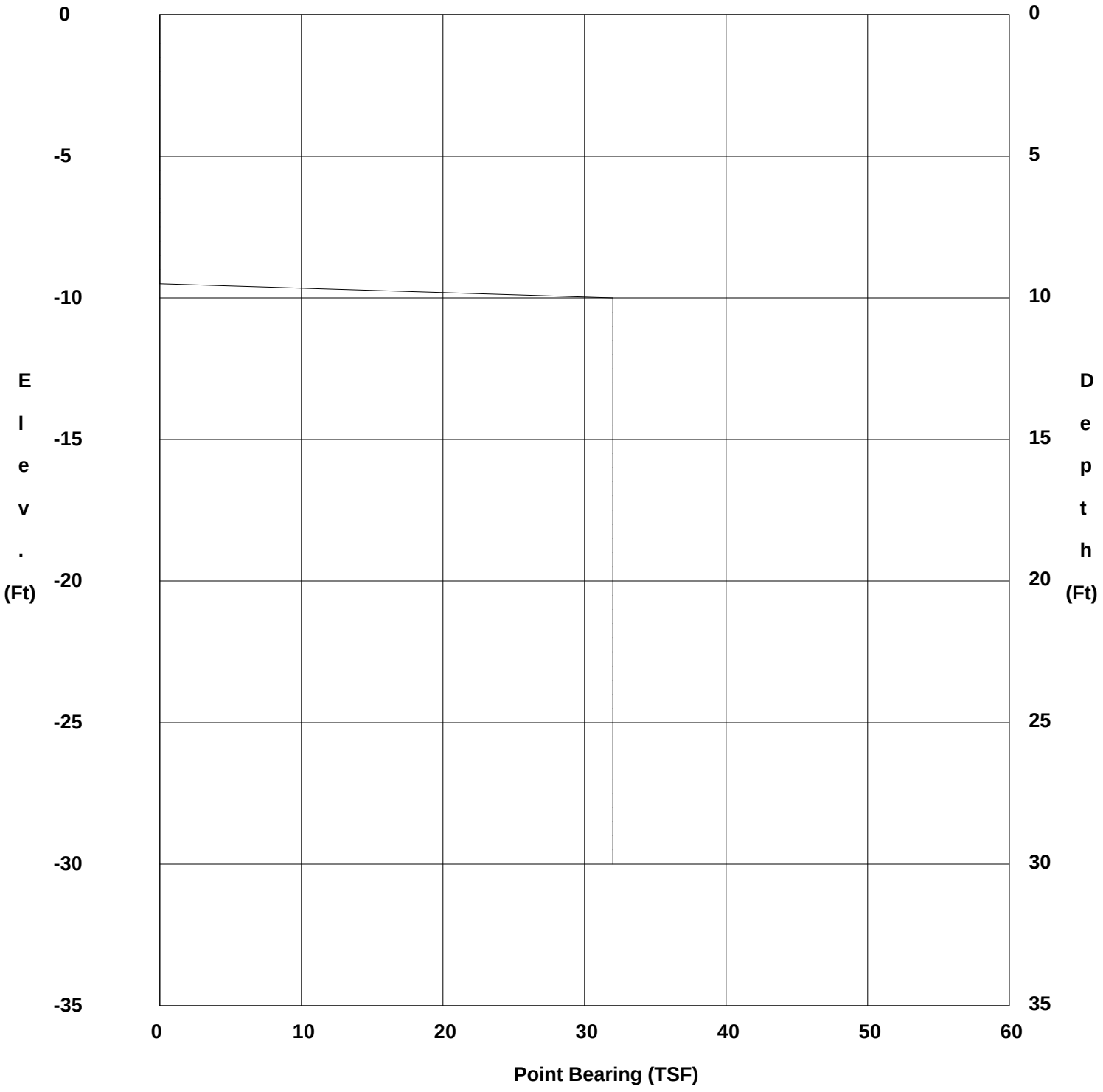
POINT BEARING DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 1	District	Dallas
Highway	N/A	Structure	Office Building	Date	06/29/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Diameters Below Tip Checked = 2

TCP Bearing Values Used



SOIL STRENGTH ANALYSIS

WinCore Version 3.1

County	**Collin**	**Hole**	**BP- 2**	**District**	**Dallas**
Highway	**N/A**	**Structure**	**Office Building**	**Date**	**07/2/2020**
Control	**N/A**	**Station**	**N/A**	**Grnd. Elev.**	**0.00 ft**
		Offset	**N/A**	**GW Elev.**	**N/A**

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet) From	To	Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
1	0.0	-3.0	CH	50	0	0.00	0.00
2	-3.0	-8.0	CH	50	48	0.67	3.36
3	-8.0	-10.0	OTHER	50	0	0.00	3.36
4	-10.0	-13.0	OTHER	80	1200	3.25	13.11
4	-13.0	-18.0	OTHER	80	1600	3.25	29.36
4	-18.0	-23.0	OTHER	80	2400	3.25	45.61
4	-23.0	-27.5	OTHER	80	2400	3.25	60.24
4	-27.5	-30.0	OTHER	80	2400	3.25	68.36

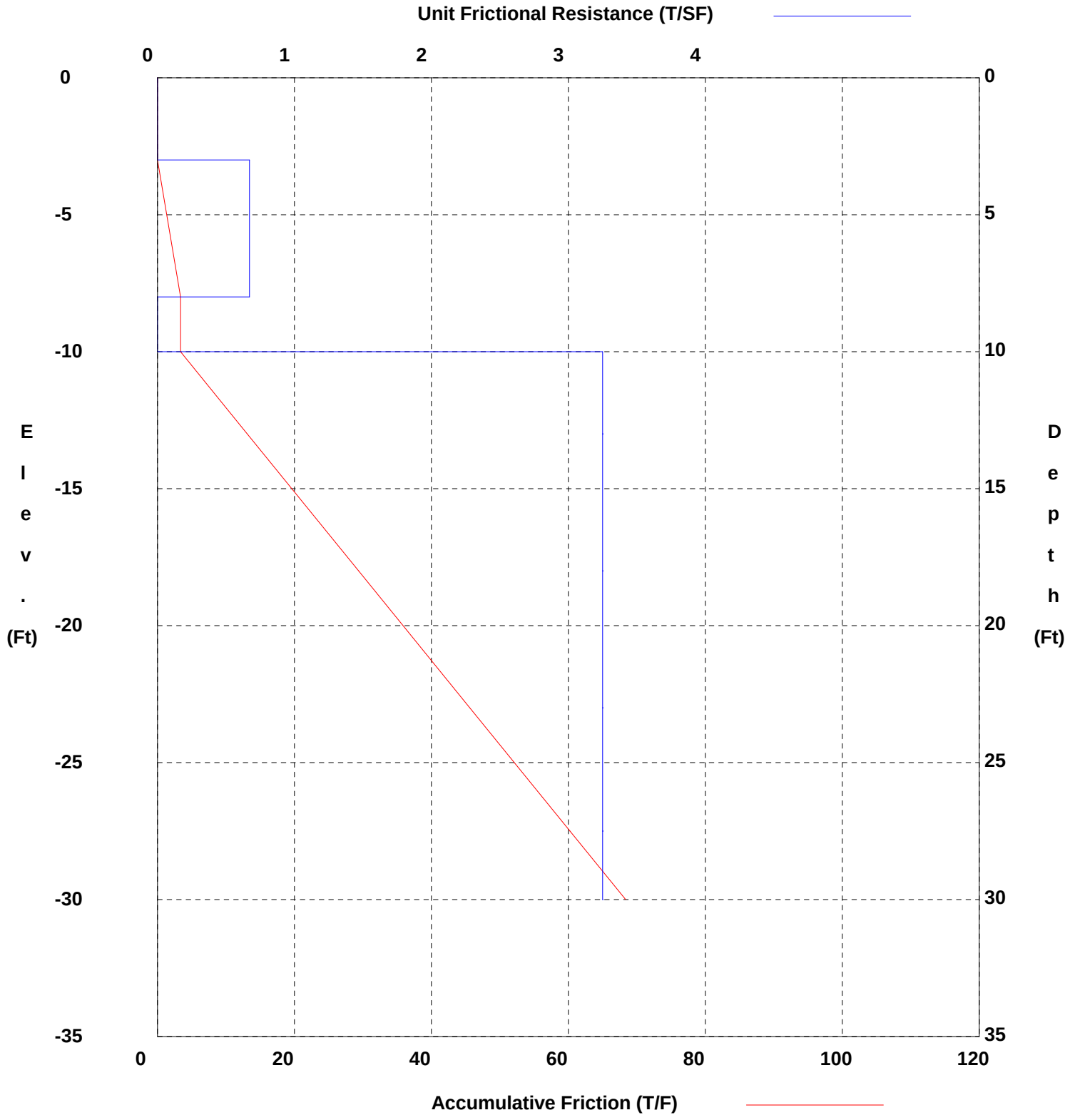
SKIN FRICTION DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 2	District	Dallas
Highway	N/A	Structure	Office Building	Date	07/2/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Drilled Shaft Design: Soil Reduction Factor = 0.7

TCP Friction Values Used



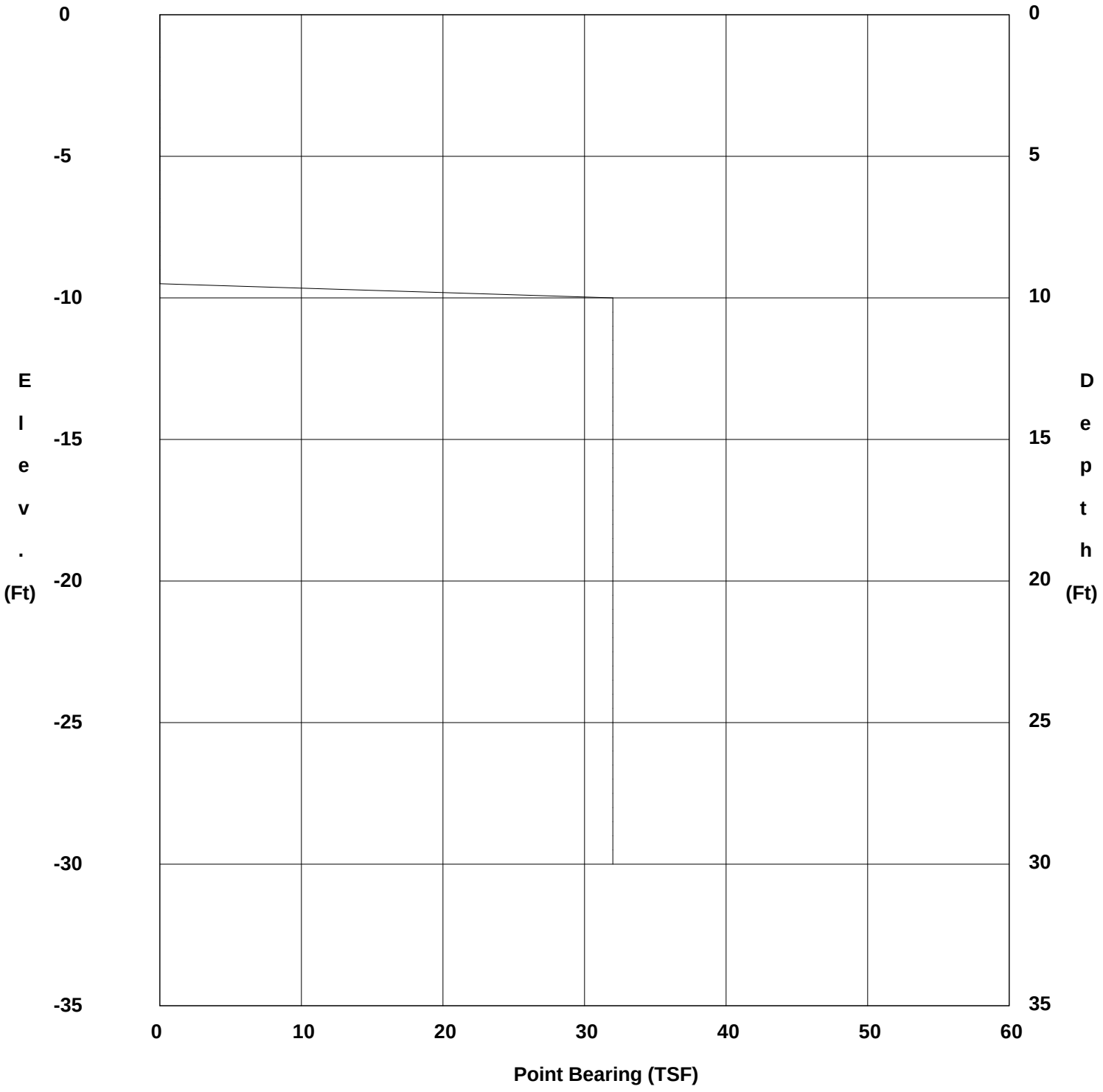
POINT BEARING DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 2	District	Dallas
Highway	N/A	Structure	Office Building	Date	07/2/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Diameters Below Tip Checked = 2

TCP Bearing Values Used



SOIL STRENGTH ANALYSIS

WinCore Version 3.1

County	**Collin**	**Hole**	**BP- 3**	**District**	**Dallas**
Highway	**N/A**	**Structure**	**Office Building**	**Date**	**06/29/2020**
Control	**N/A**	**Station**	**N/A**	**Grnd. Elev.**	**0.00 ft**
		Offset	**N/A**	**GW Elev.**	**N/A**

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet) From	To	Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
1	0.0	-5.0	CL	60	0	0.00	0.00
2	-5.0	-10.0	OTHER	80	320	1.80	9.00
3	-10.0	-13.0	OTHER	80	400	2.25	15.74
3	-13.0	-18.0	OTHER	80	1600	3.25	31.99
3	-18.0	-23.0	OTHER	80	2400	3.25	48.24
3	-23.0	-27.5	OTHER	80	2400	3.25	62.87
3	-27.5	-30.0	OTHER	80	2400	3.25	70.99

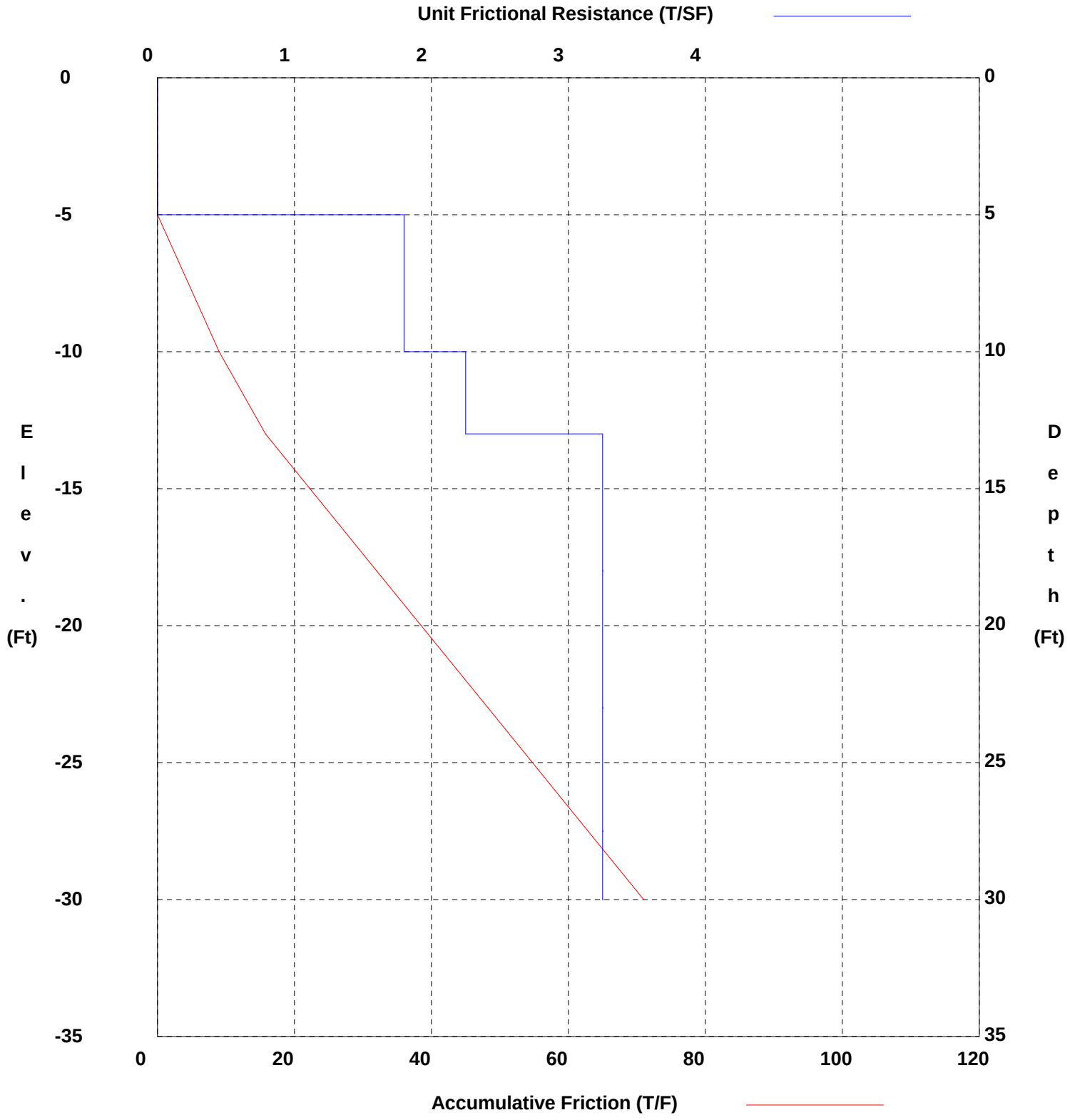
SKIN FRICTION DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 3	District	Dallas
Highway	N/A	Structure	Office Building	Date	06/29/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Drilled Shaft Design: Soil Reduction Factor = 0.7

TCP Friction Values Used



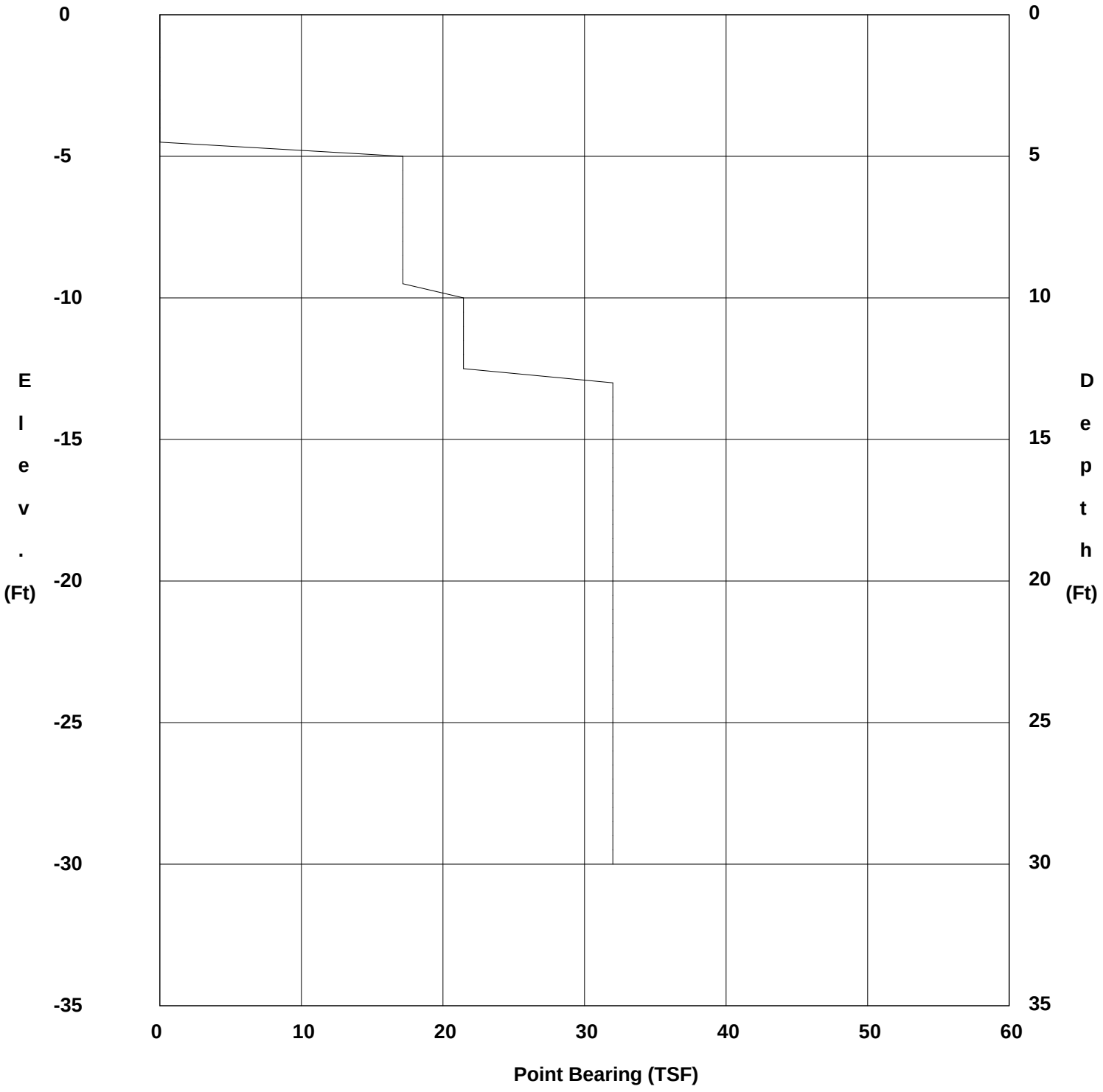
POINT BEARING DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 3	District	Dallas
Highway	N/A	Structure	Office Building	Date	06/29/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Diameters Below Tip Checked = 2

TCP Bearing Values Used



SOIL STRENGTH ANALYSIS

WinCore Version 3.1

County	**Collin**	**Hole**	**BP- 4**	**District**	**Dallas**
Highway	**N/A**	**Structure**	**Office Building**	**Date**	**07/2/2020**
Control	**N/A**	**Station**	**N/A**	**Grnd. Elev.**	**0.00 ft**
		Offset	**N/A**	**GW Elev.**	**N/A**

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet) From	To	Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
1	0.0	-6.0	CH	50	6	0.08	0.50
2	-6.0	-8.0	CL	60	0	0.00	0.50
3	-8.0	-10.0	OTHER	60	0	0.00	0.50
4	-10.0	-13.0	OTHER	80	480	2.70	8.60
4	-13.0	-18.0	OTHER	80	1600	3.25	24.85
4	-18.0	-23.0	OTHER	80	2400	3.25	41.10
4	-23.0	-28.0	OTHER	80	2400	3.25	57.35
4	-28.0	-32.5	OTHER	80	2400	3.25	71.98
4	-32.5	-35.0	OTHER	80	2400	3.25	80.10

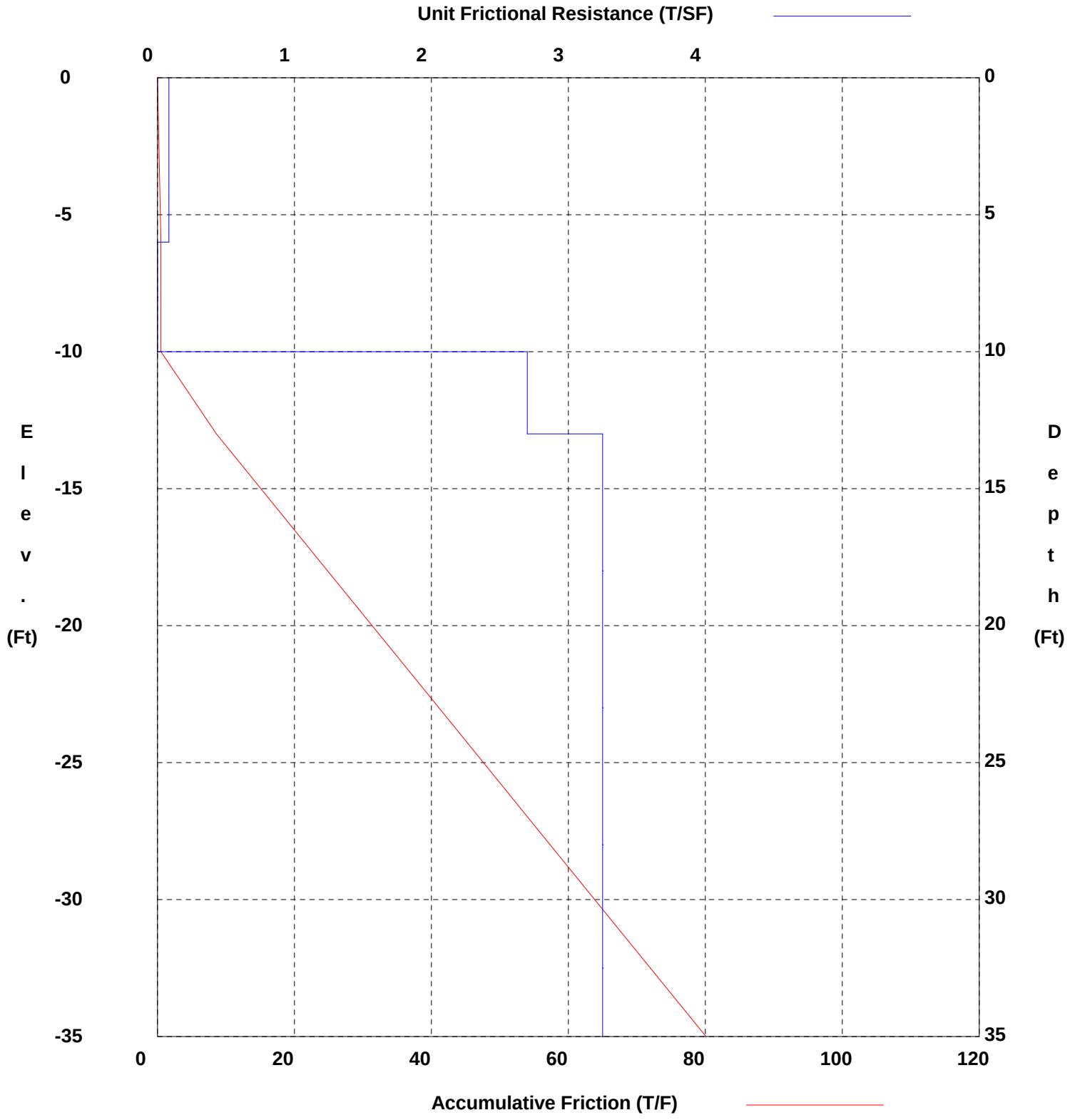
SKIN FRICTION DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 4	District	Dallas
Highway	N/A	Structure	Office Building	Date	07/2/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Drilled Shaft Design: Soil Reduction Factor = 0.7

TCP Friction Values Used



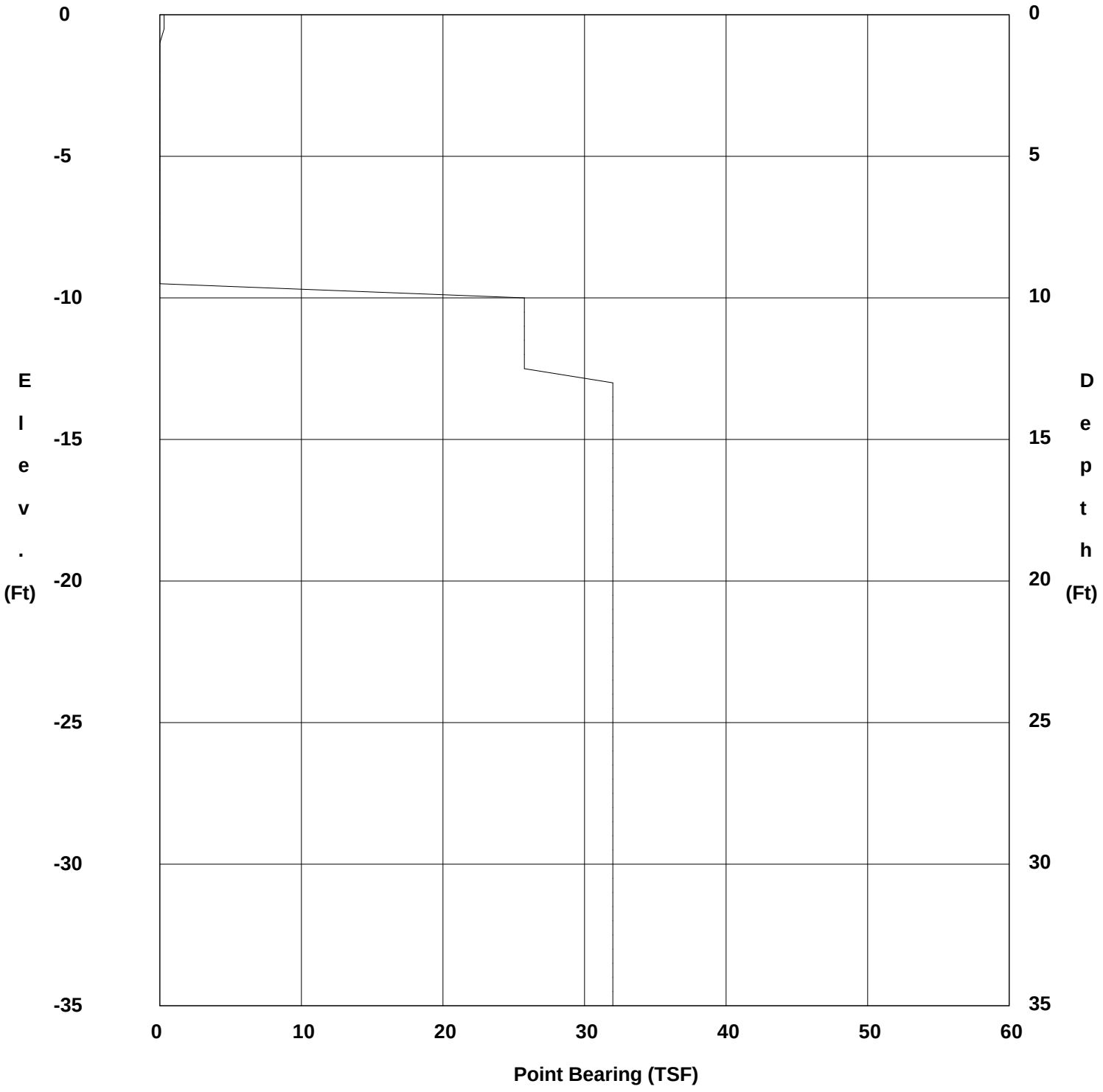
POINT BEARING DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 4	District	Dallas
Highway	N/A	Structure	Office Building	Date	07/2/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Diameters Below Tip Checked = 2

TCP Bearing Values Used



SOIL STRENGTH ANALYSIS

WinCore Version 3.1

County	**Collin**	**Hole**	**BP- 6**	**District**	**Dallas**
Highway	**N/A**	**Structure**	**Office Building**	**Date**	**06/30/2020**
Control	**N/A**	**Station**	**N/A**	**Grnd. Elev.**	**0.00 ft**
		Offset	**N/A**	**GW Elev.**	**N/A**

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet) From	To	Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
1	0.0	-0.7	OTHER	50	0	0.00	0.00
2	-0.7	-1.0	OTHER	50	0	0.00	0.00
3	-1.0	-8.0	CH	50	35	0.49	3.43
4	-8.0	-15.0	OTHER	80	400	2.25	19.17
5	-15.0	-18.0	OTHER	80	2400	3.25	28.92
5	-18.0	-23.0	OTHER	80	1200	3.25	45.17
5	-23.0	-28.0	OTHER	80	2400	3.25	61.42
5	-28.0	-32.5	OTHER	80	2400	3.25	76.05
5	-32.5	-35.0	OTHER	80	2400	3.25	84.17

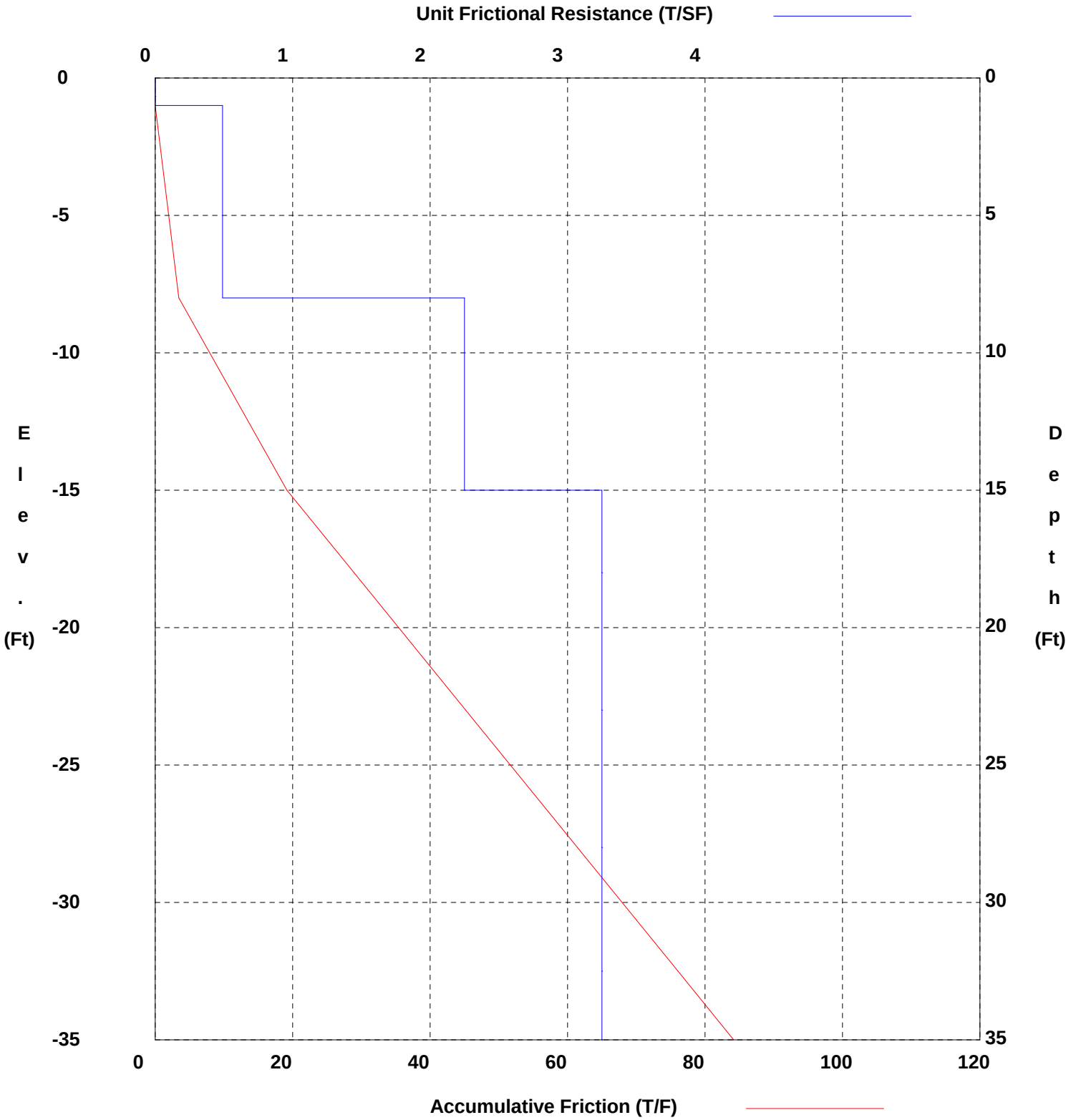
SKIN FRICTION DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 6	District	Dallas
Highway	N/A	Structure	Office Building	Date	06/30/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Drilled Shaft Design: Soil Reduction Factor = 0.7

TCP Friction Values Used



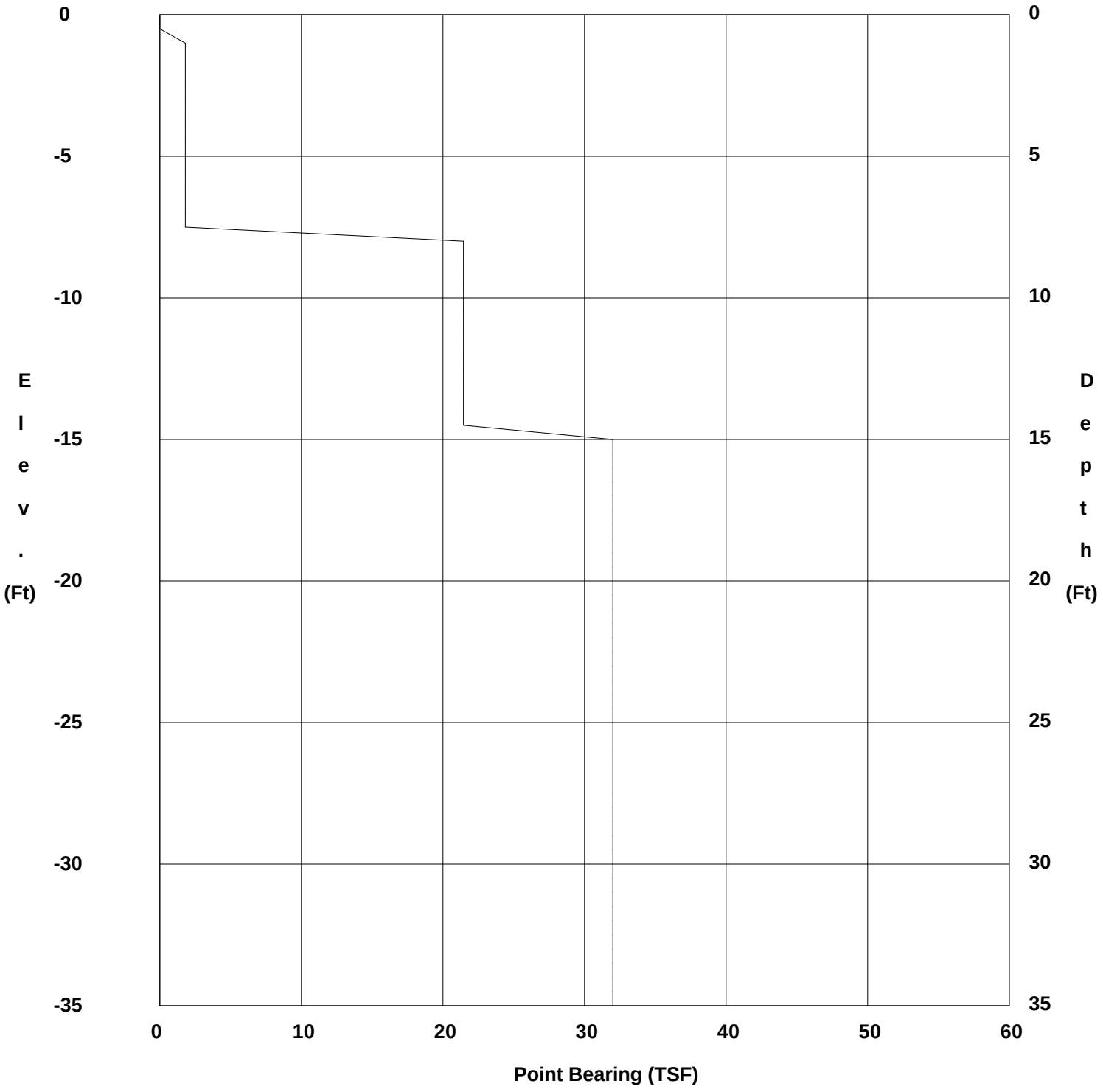
POINT BEARING DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 6	District	Dallas
Highway	N/A	Structure	Office Building	Date	06/30/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Diameters Below Tip Checked = 2

TCP Bearing Values Used



SOIL STRENGTH ANALYSIS

WinCore Version 3.1

County	**Collin**	**Hole**	**BP- 7**	**District**	**Dallas**
Highway	**N/A**	**Structure**	**Office Building**	**Date**	**06/30/2020**
Control	**N/A**	**Station**	**N/A**	**Grnd. Elev.**	**0.00 ft**
		Offset	**N/A**	**GW Elev.**	**N/A**

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet) From	To	Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
1	0.0	-0.3	OTHER	80	0	0.00	0.00
2	-0.3	-8.0	CL	60	18	0.21	1.63
3	-8.0	-15.0	OTHER	80	436	2.45	18.80
4	-15.0	-18.0	OTHER	80	1600	3.25	28.55
4	-18.0	-23.0	OTHER	80	2400	3.25	44.80
4	-23.0	-28.0	OTHER	80	2400	3.25	61.05
4	-28.0	-32.5	OTHER	80	2400	3.25	75.68
4	-32.5	-35.0	OTHER	80	2400	3.25	83.80

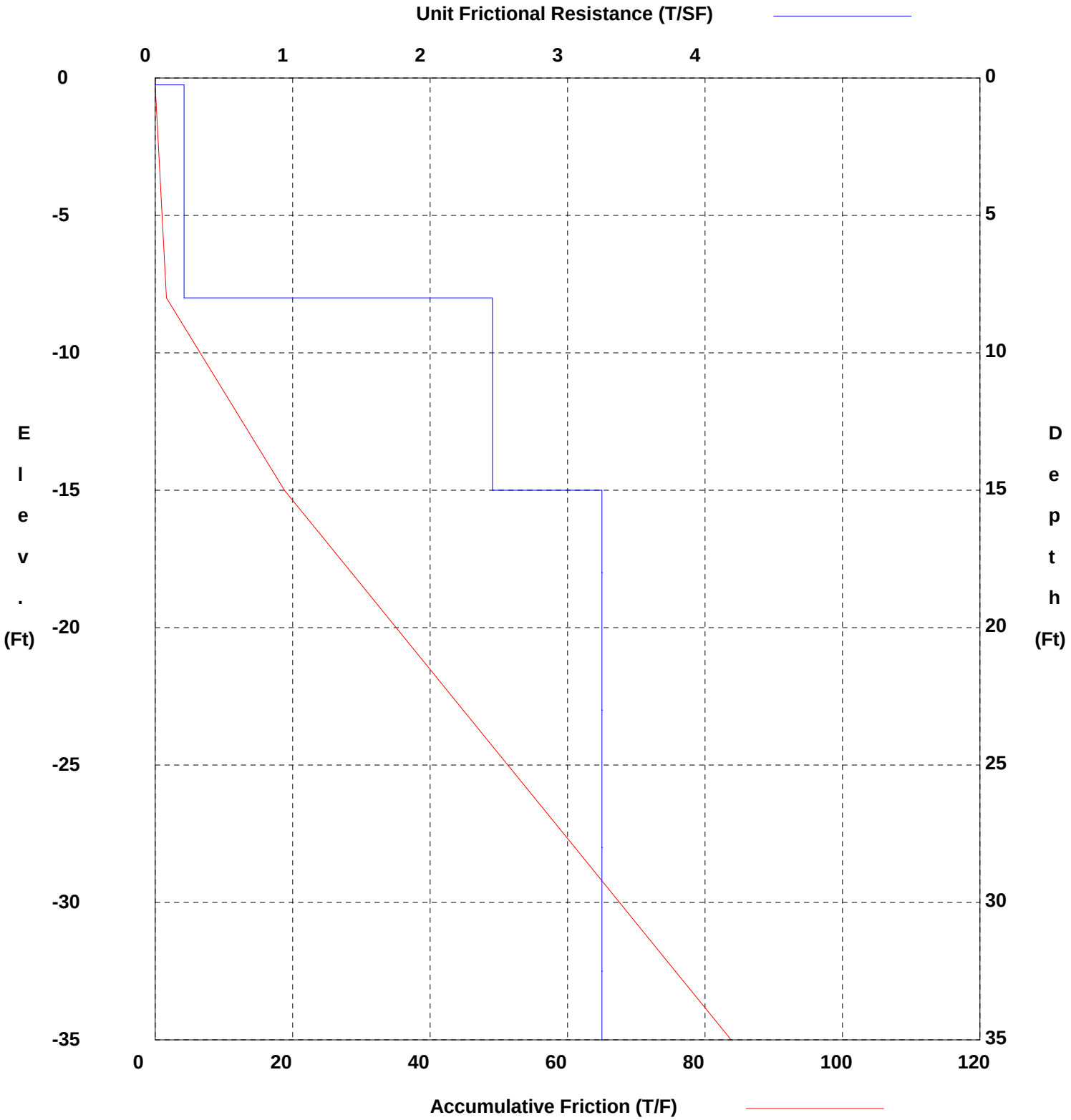
SKIN FRICTION DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 7	District	Dallas
Highway	N/A	Structure	Office Building	Date	06/30/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Drilled Shaft Design: Soil Reduction Factor = 0.7

TCP Friction Values Used



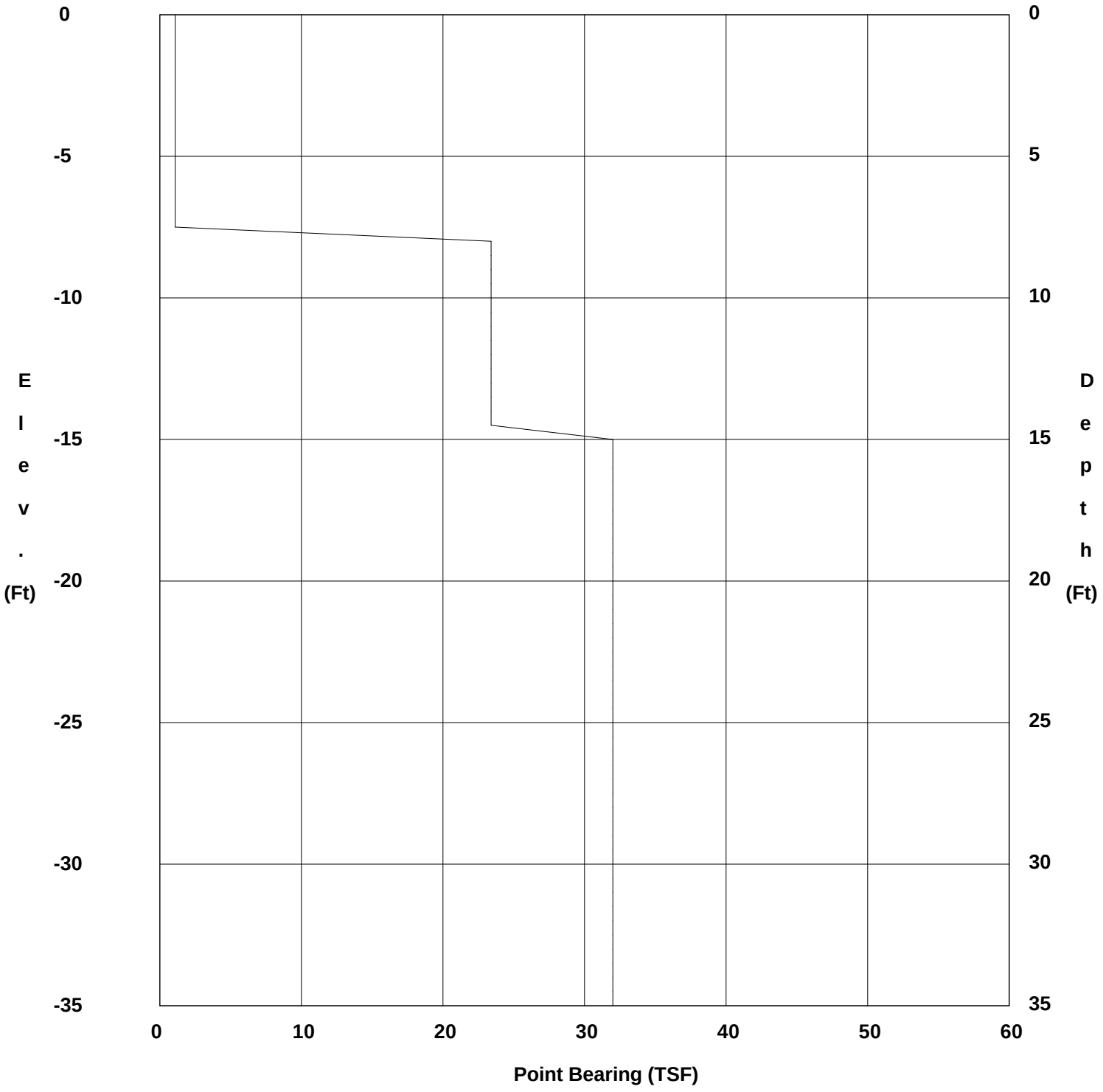
POINT BEARING DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 7	District	Dallas
Highway	N/A	Structure	Office Building	Date	06/30/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Diameters Below Tip Checked = 2

TCP Bearing Values Used



SOIL STRENGTH ANALYSIS

WinCore Version 3.1

County	**Collin**	**Hole**	**BP- 9**	**District**	**Dallas**
Highway	**N/A**	**Structure**	**Office Building**	**Date**	**07/1/2020**
Control	**N/A**	**Station**	**N/A**	**Grnd. Elev.**	**0.00 ft**
		Offset	**N/A**	**GW Elev.**	**N/A**

TCP Capacity Values Used

Soil reduction factor of 0.7 applied

Strata No.	Elev. (Feet) From	To	Design Type	Soil Factor	TCP N Value	TCP Unit Friction (TSF)	Accumulative Friction (T/F)
1	0.0	-0.2	OTHER	60	0	0.00	0.00
2	-0.2	-2.0	OTHER	60	0	0.00	0.00
3	-2.0	-6.0	CH	50	14	0.20	0.78
4	-6.0	-10.0	OTHER	50	0	0.00	0.78
5	-10.0	-13.0	OTHER	80	800	3.25	10.53
5	-13.0	-18.0	OTHER	80	1600	3.25	26.78
5	-18.0	-23.0	OTHER	80	2400	3.25	43.03
5	-23.0	-28.0	OTHER	80	1200	3.25	59.28
5	-28.0	-32.5	OTHER	80	2400	3.25	73.91
5	-32.5	-35.0	OTHER	80	2400	3.25	82.03

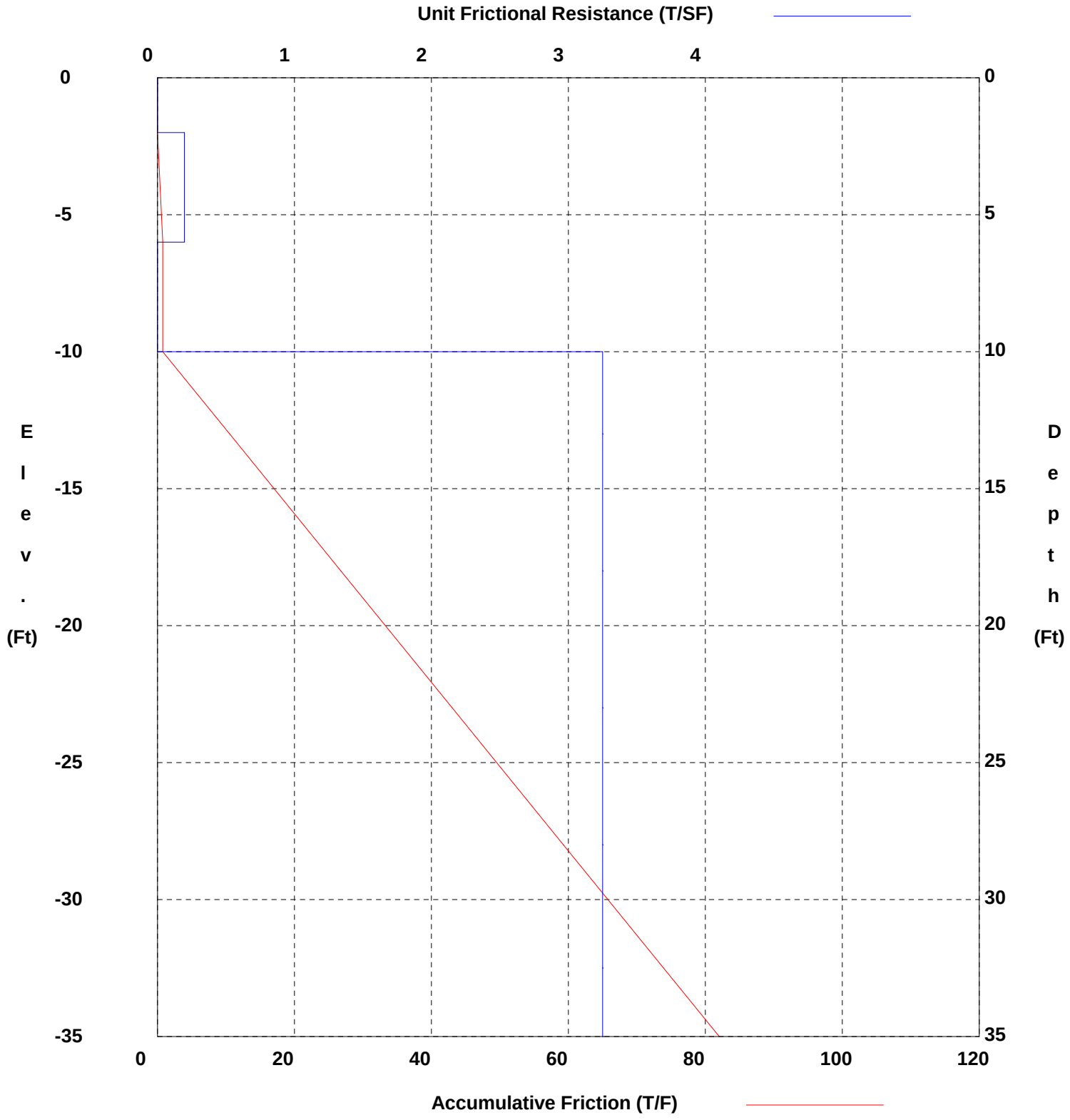
SKIN FRICTION DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 9	District	Dallas
Highway	N/A	Structure	Office Building	Date	07/1/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Drilled Shaft Design: Soil Reduction Factor = 0.7

TCP Friction Values Used



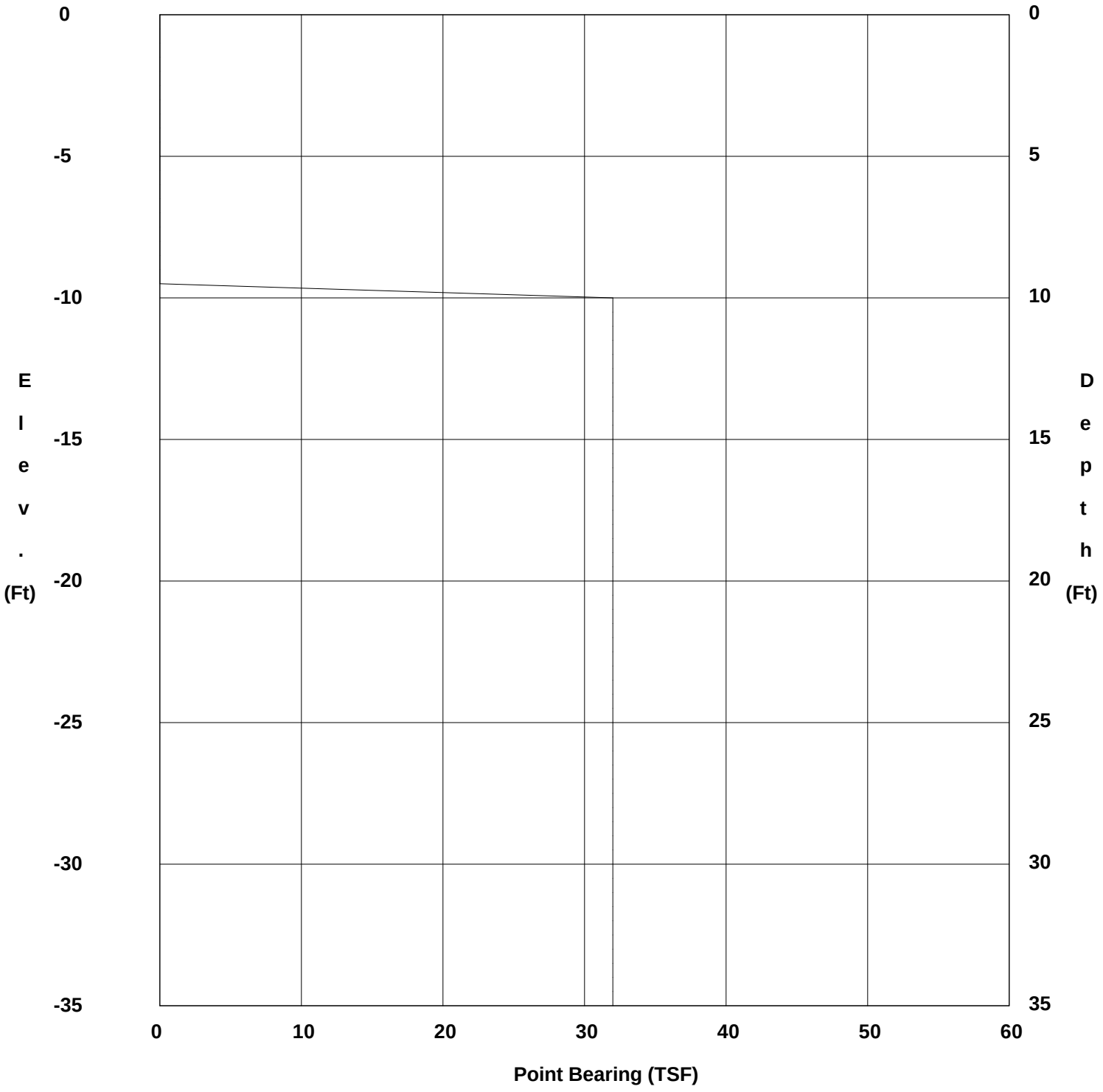
POINT BEARING DESIGN

WinCore
Version 3.1

County	Collin	Hole	BP- 9	District	Dallas
Highway	N/A	Structure	Office Building	Date	07/1/2020
Control	N/A	Station	N/A	Grnd. Elev.	0.00 ft
		Offset	N/A	GW Elev.	N/A

Diameters Below Tip Checked = 2

TCP Bearing Values Used



APPENDIX E

LPILE PARAMETERS

Company Name: HVJ Associates, Inc
Project: McKinney Area Engineer and Maintenance Facility
Location: Collin County, Texas
Project Number: HG1710036.2.2

Boring No.	LPILE Parameters												
	Depth (feet)	P-Y Curve Model	Total Unit Weight (pcf)	Undrained Cohesion, Su (psf)	Friction angle, ϕ	Soil Modulus Parameter (psi)	Static Modulus of Subgrade Reaction (pci)	Strain Factor, ε_{50}	Uniaxial Compressive Strength (psi)	GSI (%)	Initial Rock Mass Modulus, E_m(psi)	RQD	Strain Factor, K_{rm}
BP-1	0 to 7	Mod. Stiff Clay Without Free Water	124	5000	-	-	2000	0.004		-	-	-	-
	7.0 to 22	Weak Rock (Reese)	146	-			-	-	1009	20	68028	50	0.0005
	22 to 30	Weak Rock (Reese)	145	-	-	-	-	-	1018.5	50	384345	80	0.0005
BP-2	0 to 7	Mod. Stiff Clay Without Free Water	111	5000	-	-	2000	0.004	-	-		-	-
	7 to 30	Weak Rock (Reese)	145	-	-	-	-	-	1028	40	217139	90	0.0005
BP-3	0 to 10	Mod. Stiff Clay Without Free Water	115	5000	-	-	2000	0.004			-		
	10 to 30	Weak Rock (Reese)	145	-	-	-	-	-	1788	50	509242	-	0.0005
BP-4	0 to 7	Mod. Stiff Clay Without Free Water	119	400	-	-	30	0.02	-	-	-	-	-
	7 to 13	Weak Rock (Reese)	141	-	-	-	-	-	272	40	111693	50	0.0005
	13 to 35	Weak Rock (Reese)	143	-	-	-	-	-	1288	60	768597	90	0.0005
BP-6	0 to 8	Mod. Stiff Clay Without Free Water	125	2800	-	-	500	0.007	-	-	-	-	-
	8 to 15	Weak Rock (Reese)	145	-	-	-	-	-	514	20	48554	38	0.0005
	15 to 35	Weak Rock (Reese)	145	-	-	-		-	1210.5	50	419009	88	0.0005
BP-7	0 to 8	Mod. Stiff Clay Without Free Water	111	1200	-	-	100	0.01	-	-	-	-	-
	8 to 16	Weak Rock (Reese)	141	-	-	-	-	-	263	20	34731	38	0.0005
	15 to 35	Weak Rock (Reese)	145	-	-	-		-	722	50	323600	95	0.0005
BP-9	0 to 6	Mod. Stiff Clay Without Free Water	112	1120	-	-	500	0.007	-	-	-	-	-
	6 to 10	Sand (Reese)	120	-	36	225	-	-	-	-	-	-	-
	10 to 16	Weak Rock (Reese)	145	-	-	-	-	-	1763	15	67432	12	0.0005
	16 to 35	Weak Rock (Reese)	148	-	-	-	-	-	1624	50	485326	91	0.0005

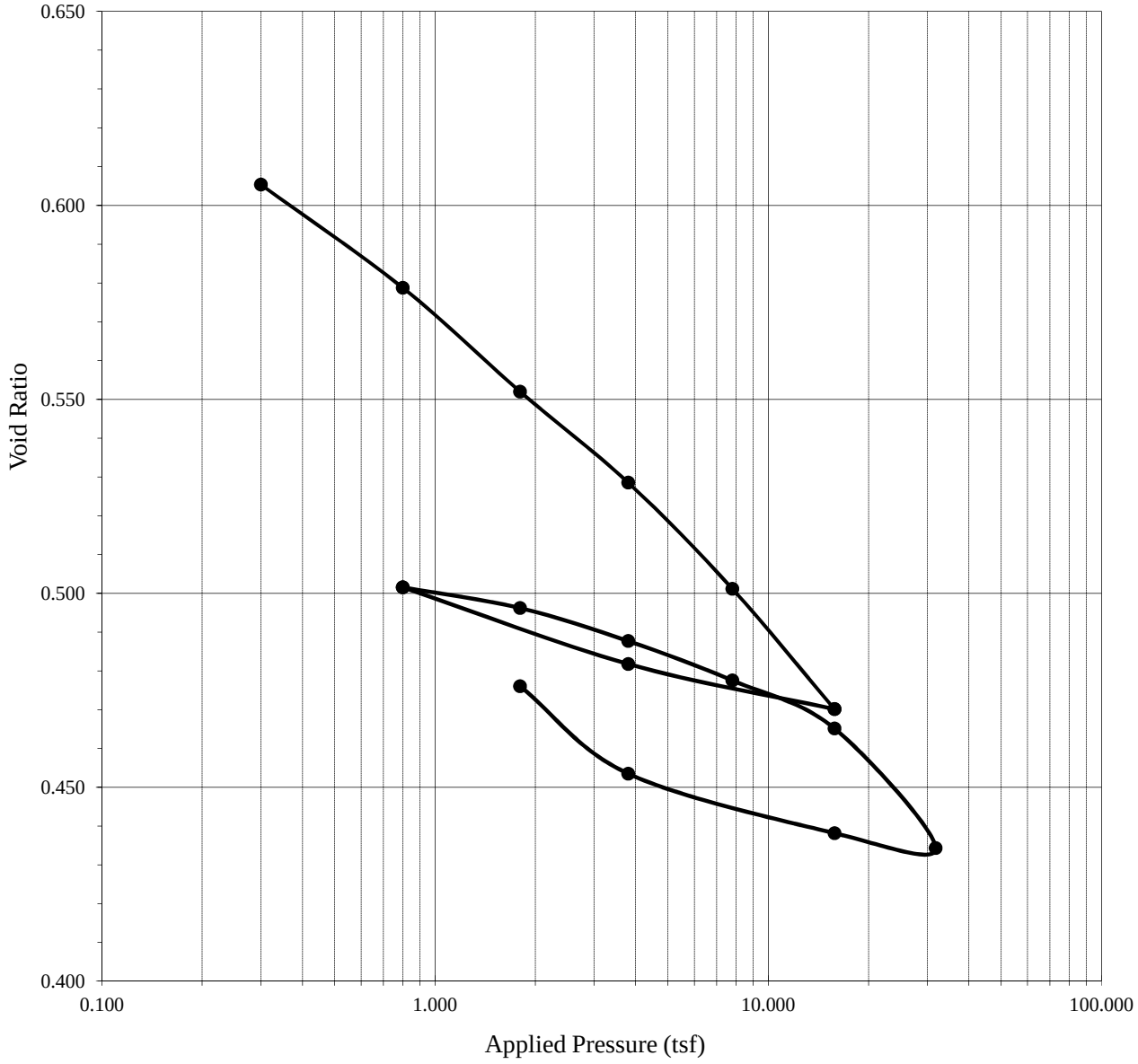
APPENDIX F

CONSOLIDATION TEST RESULTS

HVJ NORTH TEXAS - CHELLIAH CONSULTANTS, INC.
CONSOLIDATION TEST GRAPHS

Project Name:	TXDOT DALLAS	Boring No.	BP-4
Project No.	2020_HG1710036.2.2	Sample Depth (ft.)	8-9.5
		Compression Index, Cc	0.115
		Recompression Index, Cr	0.024
		Preconsolidation Pressure, Pc' (tsf)	2.60

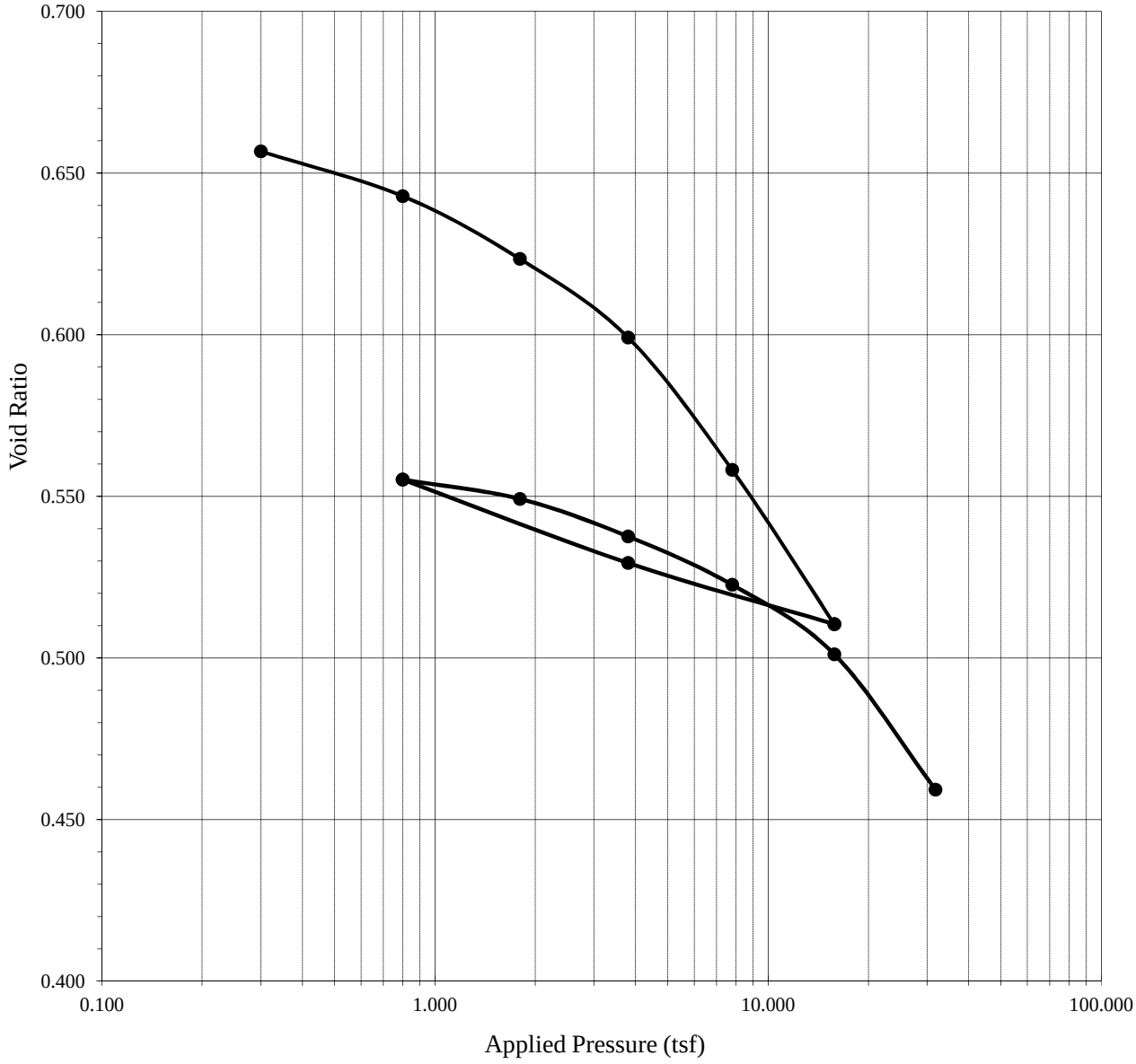
Void Ratio - Log(p) Curve



HVJ NORTH TEXAS - CHELLIAH CONSULTANTS, INC.
CONSOLIDATION TEST GRAPHS

Project Name:	TXDOT DALLAS	Boring No.	BP-7
Project No.	2020_HG1710036.2.2	Sample Depth (ft.)	6-8
		Compression Index, Cc	0.155
		Recompression Index, Cr	0.034
		Preconsolidation Pressure, Pc' (tsf)	3.10

Void Ratio - Log(p) Curve



APPENDIX G

PAVEMENT AND REINFORCEMENT DETAILS

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Rigid Structural Design Module

TxDOT Dallas McKinney Area Office - Concrete Pavement

Rigid Structural Design

Pavement Type	JRCP
18-kip ESALs Over Initial Performance Period	294,268
Initial Serviceability	4.5
Terminal Serviceability	2.5
28-day Mean PCC Modulus of Rupture	570 psi
28-day Mean Elastic Modulus of Slab	3,600,000 psi
Mean Effective k-value	93 psi/in
Reliability Level	95 %
Overall Standard Deviation	0.39
Load Transfer Coefficient, J	2.9
Overall Drainage Coefficient, Cd	1
Calculated Design Thickness	6.20 in

Effective Modulus of Subgrade Reaction

Period	Description	Roadbed Soil Resilient Modulus (psi)	Base Elastic Modulus (psi)
1	-	4,650	20,000

Base Type	Stabilized Subgrade
Base Thickness	8 in
Depth to Bedrock	100 ft
Projected Slab Thickness	7 in
Loss of Support Category	1
Effective Modulus of Subgrade Reaction	93 psi/in

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	1,000
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	90 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	- %
Average Initial Truck Factor (ESALs/truck)	-
Annual Truck Factor Growth Rate	- %
Annual Truck Volume Growth Rate	- %
Growth	Simple

Total Calculated Cumulative ESALs - *

*Note: This value is not represented by the inputs or an error occurred in calculation.

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	1,000
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	90 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	66.33	2	0.0008	2	4,488
2	11.8	2	0.0122	2	12,176
3	10.65	2	0.0052	2	4,684
4	2.36	2	0.189	2	37,725
5	1.77	2	0.1303	2	19,506
6	0.59	2	0.189	2	9,431
7	4.14	2	0.5317	2	186,177
8	1.18	2	0.189	2	18,863
9	1.18	2	0.0122	2	1,218
Total	100	-	-	-	294,268

Growth Simple

Total Calculated Cumulative ESALs 294,268

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

TxDOT Dallas McKinney Area Office - Concrete Pavement

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	294,268
Initial Serviceability	4.2
Terminal Serviceability	2.2
Reliability Level	80 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	4,650 psi
Stage Construction	1
Calculated Design Structural Number	3.13 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	3	12	1.32
2	Crushed Limestone Base	0.14	1	9	12	1.26
3	Stabilized Subgrade	0.11	1	8	12	0.88
Total	-	-	-	20.00	-	3.46

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Rigid Structural Design Module

TxDOT Dallas McKinney Area Office - Concrete Pavement (Visitor Parking)

Rigid Structural Design

Pavement Type	JRCP
18-kip ESALs Over Initial Performance Period	205,988
Initial Serviceability	4.5
Terminal Serviceability	2.5
28-day Mean PCC Modulus of Rupture	570 psi
28-day Mean Elastic Modulus of Slab	3,600,000 psi
Mean Effective k-value	93 psi/in
Reliability Level	95 %
Overall Standard Deviation	0.39
Load Transfer Coefficient, J	2.9
Overall Drainage Coefficient, Cd	1
Calculated Design Thickness	5.80 in

Effective Modulus of Subgrade Reaction

Period	Description	Roadbed Soil Resilient Modulus (psi)	Base Elastic Modulus (psi)
1	-	4,650	20,000

Base Type	Stabilized Subgrade
Base Thickness	8 in
Depth to Bedrock	100 ft
Projected Slab Thickness	7 in
Loss of Support Category	1
Effective Modulus of Subgrade Reaction	93 psi/in

Simple ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	700
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	90 %
Percent Heavy Trucks (of ADT) FHWA Class 5 or Greater	- %
Average Initial Truck Factor (ESALs/truck)	-
Annual Truck Factor Growth Rate	- %
Annual Truck Volume Growth Rate	- %
Growth	Simple

Total Calculated Cumulative ESALs - *

*Note: This value is not represented by the inputs or an error occurred in calculation.

Rigorous ESAL Calculation

Performance Period (years)	20
Two-Way Traffic (ADT)	700
Number of Lanes in Design Direction	1
Percent of All Trucks in Design Lane	90 %
Percent Trucks in Design Direction	90 %

Vehicle Class	Percent of ADT	Annual % Growth	Average Initial Truck Factor (ESALs/ Truck)	Annual % Growth in Truck Factor	Accumulated 18-kip ESALs over Performance Period
1	66.33	2	0.0008	2	3,142
2	11.8	2	0.0122	2	8,523
3	10.65	2	0.0052	2	3,279
4	2.36	2	0.189	2	26,408
5	1.77	2	0.1303	2	13,654
6	0.59	2	0.189	2	6,602
7	4.14	2	0.5317	2	130,324
8	1.18	2	0.189	2	13,204
9	1.18	2	0.0122	2	852
Total	100	-	-	-	205,988

Growth Simple

Total Calculated Cumulative ESALs 205,988

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

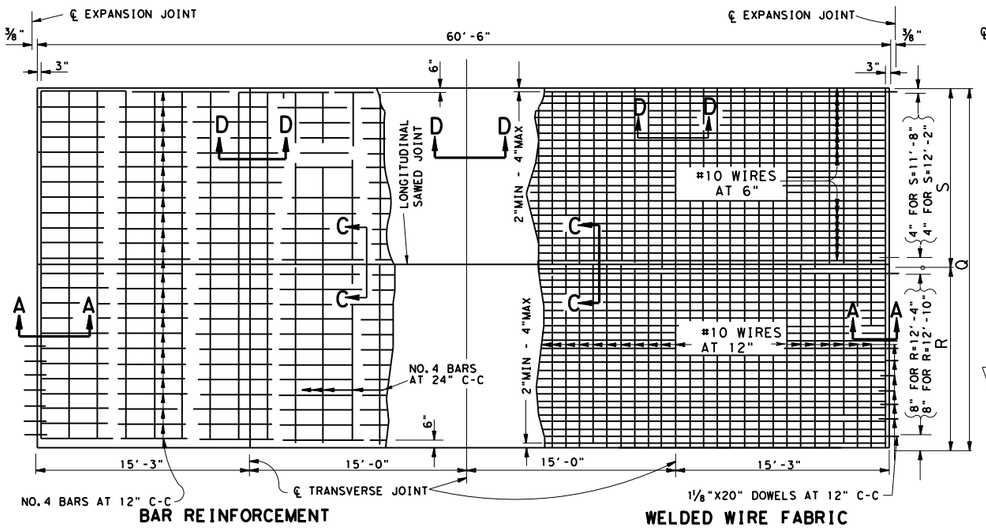
TxDOT Dallas McKinney Area Office - Concrete Pavement (Visitor Parking)

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	205,988
Initial Serviceability	4.2
Terminal Serviceability	2.2
Reliability Level	80 %
Overall Standard Deviation	0.49
Roadbed Soil Resilient Modulus	4,650 psi
Stage Construction	1
Calculated Design Structural Number	2.96 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	2	12	0.88
2	Crushed Limestone Base	0.14	1	9	12	1.26
3	Stabilized Subgrade	0.11	1	8	12	0.88
Total	-	-	-	19.00	-	3.02

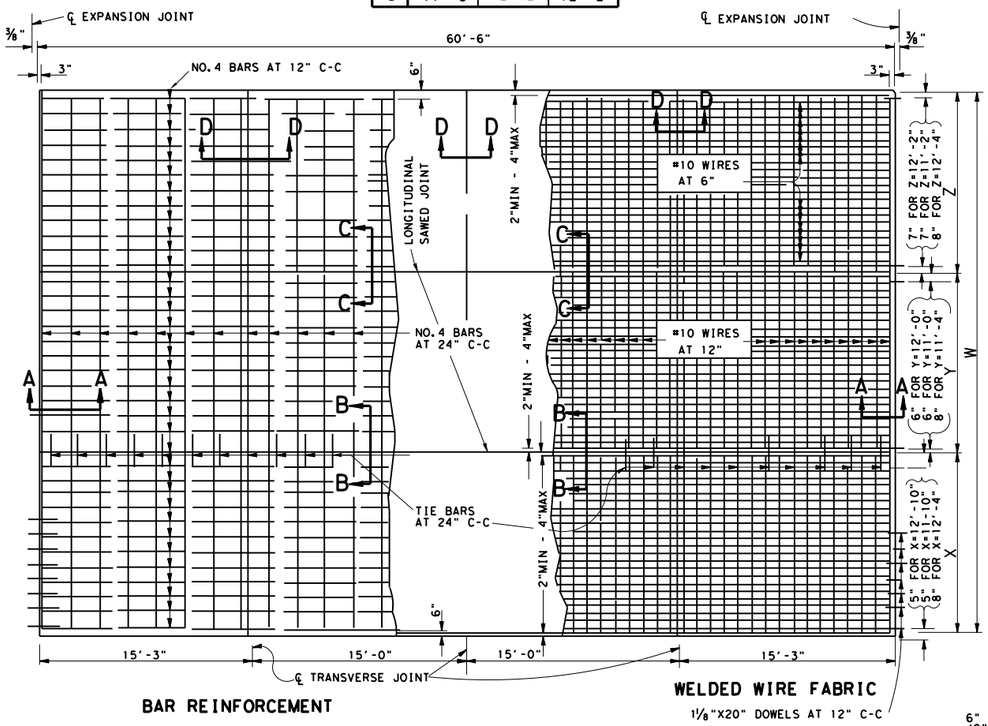


BAR REINFORCEMENT

WELDED WIRE FABRIC

TWO LANE PAVEMENT PLAN

	WIDTH - Q		
	24'-0"	24'-6"	25'-0"
R	12'-4"	12'-4"	12'-10"
S	11'-8"	12'-2"	12'-2"



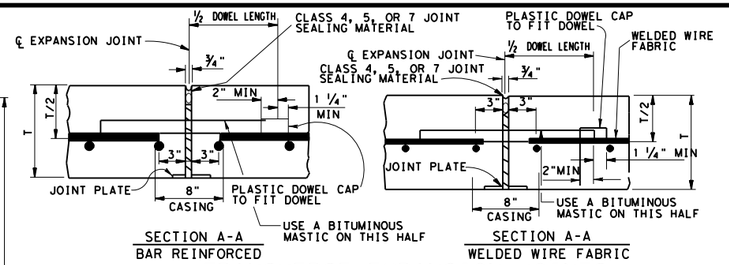
BAR REINFORCEMENT

WELDED WIRE FABRIC

THREE LANE PAVEMENT PLAN

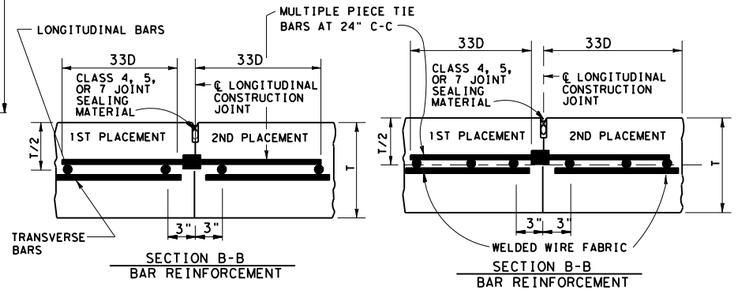
	WIDTH - W		
	37'-0"	36'-0"	34-0"
X	12'-10"	12'-4"	11'-10"
Y	12'-0"	11'-4"	11'-0"
Z	12'-2"	12'-4"	11'-2"

D = DIAMETER
R = RADIUS
T = THICKNESS

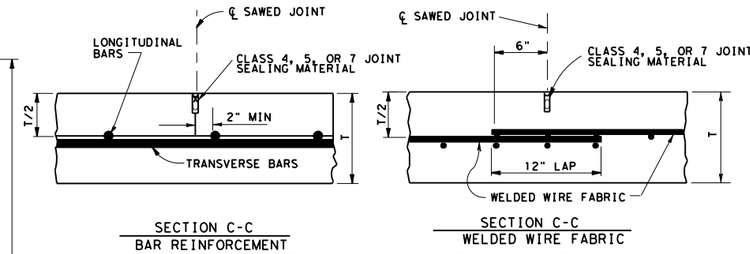


TRANSVERSE EXPANSION JOINTS

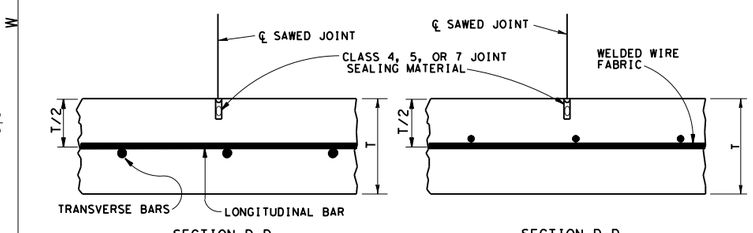
NOTE: DOWEL BARS CONFORMING TO ASTM A615 OR A616 GRADE 60 ARE ACCEPTABLE



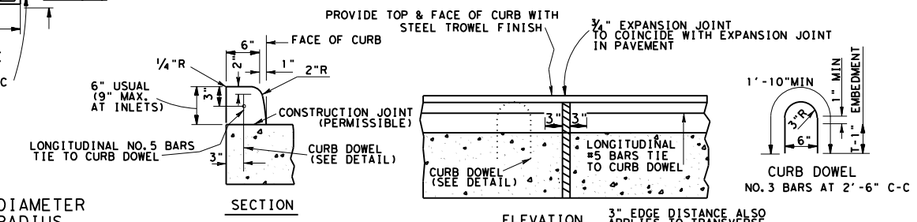
LONGITUDINAL CONSTRUCTION JOINTS



LONGITUDINAL SAWED JOINTS



TRANSVERSE SAWED JOINTS



3" EDGE DISTANCE ALSO APPLIES TO TRANSVERSE GROOVED PLANE JOINT IN CURB

TYPICAL 6" CURB (DETAIL)

GENERAL NOTES

1. MULTIPLE PIECE TIE BARS ARE REQUIRED AT LONGITUDINAL CONSTRUCTION JOINTS. USE MULTIPLE PIECE TIE BAR ASSEMBLIES WITH STOP TYPE COUPLINGS AND WITH THREADS ON THE BARS. ENSURE THE MULTIPLE PIECE TIE BAR ASSEMBLIES DEVELOP A MINIMUM ULTIMATE TENSILE STRENGTH EQUAL TO 1.25 TIMES THE YIELD STRENGTH OF THE TRANSVERSE BARS BEING JOINED. USE DEFORMED REINFORCING BARS FOR TIE BARS. TIE BAR ASSEMBLIES MADE FROM STEELS OTHER THAN ASTM GRADE 60 AND WITH DEFORMATIONS OTHER THAN ASTM STANDARD MAY BE USED IF IT CAN BE PROVEN TO THE ENGINEER THAT THEY ARE IN EVERY RESPECT THE EQUAL OF THE ASSEMBLIES SPECIFIED. LABORATORY TESTING OF THE PROPOSED ASSEMBLIES, AT THE CONTRACTOR'S EXPENSE, MAY BE REQUIRED.
2. FORM CONSTRUCTION JOINTS WITH METAL OR WOOD FORMS EQUAL IN DEPTH TO THE NOMINAL DEPTH OF THE PAVEMENT OR BY OTHER MEANS APPROVED PRIOR TO THEIR USE.
3. SAW LONGITUDINAL AND TRANSVERSE JOINTS AS SOON AS SAWING CAN BE ACCOMPLISHED WITHOUT DAMAGE TO THE PAVEMENT AND BEFORE 24 HOURS AFTER PLACING THE CONCRETE, THE EXACT TIME WILL BE APPROVED BY THE ENGINEER. PREFORMED JOINT WITH ASPHALT STRIP IS NOT ACCEPTABLE.
4. LONGITUDINAL JOINTS ARE SHOWN OFFSET FOUR INCHES FROM THE THEORETICAL LANE LINE AND MAY BE OFFSET TO EITHER SIDE IF THE WIDTH OF THE WIRE FABRIC IS PROPERLY ADJUSTED.
5. ONE OF THE LONGITUDINAL JOINTS OF PAVEMENT SLABS WIDER THAN TWO LANES MAY BE A CONSTRUCTION JOINT. FOR PAVEMENT SLABS WIDER THAN 15 FT. PROVIDE A LONGITUDINAL SAWED JOINT UNLESS OTHERWISE DIRECTED.
6. FORM THE JOINT SEAL SPACE AT TRANSVERSE EXPANSION JOINTS BY USING A STRAIGHT FORM PLACED BEHIND THE LONGITUDINAL FLOAT. LOOSEN THE FORM AS SOON AS THE CONCRETE WILL RETAIN ITS SHAPE AND EDGE WITH AN APPROVED EDGING TOOL. TOOL BOTH EDGES OF LONGITUDINAL CONSTRUCTION JOINTS TO A ⅛ IN. RADIUS AT THE PAVEMENT SURFACE.
7. DO NOT DISCHARGE CONCRETE FROM THE MIXER DIRECTLY ON TOP OF OR ON THE SIDES OF THE EXPANSION JOINT ASSEMBLIES.
8. LAP TRANSVERSE EDGES OF SHEETS OF WELDED WIRE FABRIC 12 INCHES EXCEPT AT TRANSVERSE EXPANSION JOINTS. LAP LONGITUDINAL EDGES 6 INCHES EXCEPT AT LONGITUDINAL CONSTRUCTION JOINTS.
9. DOWEL BARS MAY BE COATED WITH STAINLESS STEEL, MONEL METAL, OR IN ACCORDANCE WITH THE ITEM "REINFORCING STEEL" SECTION ON EPOXY COATING; WITH A WELDED DOWEL ASSEMBLY SUPPORT, AS APPROVED. ENSURE THE CASING CONFORMS TO THE REQUIREMENTS OF ONE OF THE GRADES OF ASTM A167-70 OR A176-71 AND IS NOT LESS THAN 0.010 INCH THICK. PROVIDE A CASING AT LEAST 8 INCHES LONG AND THAT COVERS THE MIDDLE 8 INCHES OF THE DOWEL.
10. SECURE DOWELS PARALLEL TO THE PAVEMENT SURFACE AND PERPENDICULAR TO THE JOINT WITH THE AID OF APPROVED WELDED WIRE BASKET ARRANGEMENTS. ENSURE WELDED WIRE BASKET ARRANGEMENTS DO NOT CROSS THE EXPANSION JOINT. UNIFORMLY COAT DOWELS WITH A BITUMINOUS MASTIC ON THE END WITH THE DOWEL CAP.
11. DO NOT BEND TIE BARS AND DOWEL BARS. TO PREVENT DISPLACEMENT OF WIRE FABRIC BY CONCRETE PLACEMENT, TIE THE FABRIC PANEL TOGETHER AND TIE THE INITIAL FABRIC PANELS OF EACH SLAB TO THE DOWEL BASKET OR AS DIRECTED.
12. TOOL PAVEMENT EDGES TO A RADIUS OF ⅛ IN. WITH AN APPROVED EDGING TOOL.
13. DETAILS FOR PAVEMENT WIDTH, PAVEMENT THICKNESS, AND CROWN-SLOPE ARE ELSEWHERE SHOWN ON THE PLANS.
14. THE CONTRACTOR HAS THE OPTION OF USING WELDED WIRE FABRIC OR BAR REINFORCEMENT. LOCATE THE LONGITUDINAL STEEL AT THE CENTER OF THE SLAB. TAKE NECESSARY PRECAUTIONS TO INSURE THAT THE FINAL POSITION OF STEEL IS WITHIN ½ IN. OF THE SLAB CENTER. ENSURE THE LONGITUDINAL AND TRANSVERSE STEEL SPACING DOES NOT VARY MORE THAN ONE-TWELFTH OF SPACING SHOWN.
15. LONGITUDINAL STEEL MAY BE SPLICED WITH 33 TIMES BAR DIAMETER LAPS.
16. FOR LANE WIDTHS NOT SHOWN OR FOR VARIABLE PANEL LENGTHS AND WIDTHS, SPACE REINFORCING STEEL AND DOWELS AS DIRECTED.
17. USE APPROVED BAR MAT CHAIRS. DO NOT EXCEED CHAIR SPACING OF 30 IN. C-C (TRANSVERSE) AND 48 IN. C-C (LONGITUDINAL). GALVANIZING THE CHAIRS IS NOT REQUIRED.
18. OBTAIN BOARDS FOR EXPANSION JOINT FILLER FROM REDWOOD TIMBER.
19. PROVIDE AND CONSTRUCT THE JOINT PLATE AS APPROVED.
20. WHEN CURB IS PLACED SEPARATELY FROM THE CONCRETE PAVEMENT, PROVIDE THE REINFORCING STEEL AS SHOWN IN THE CURB DETAIL. THE CURB REINFORCING STEEL MAY BE OMITTED WHEN THE CURB IS PLACED MONOLITHICALLY.

(GENERAL NOTES CONTINUED ON SHEET 2 OF 2)

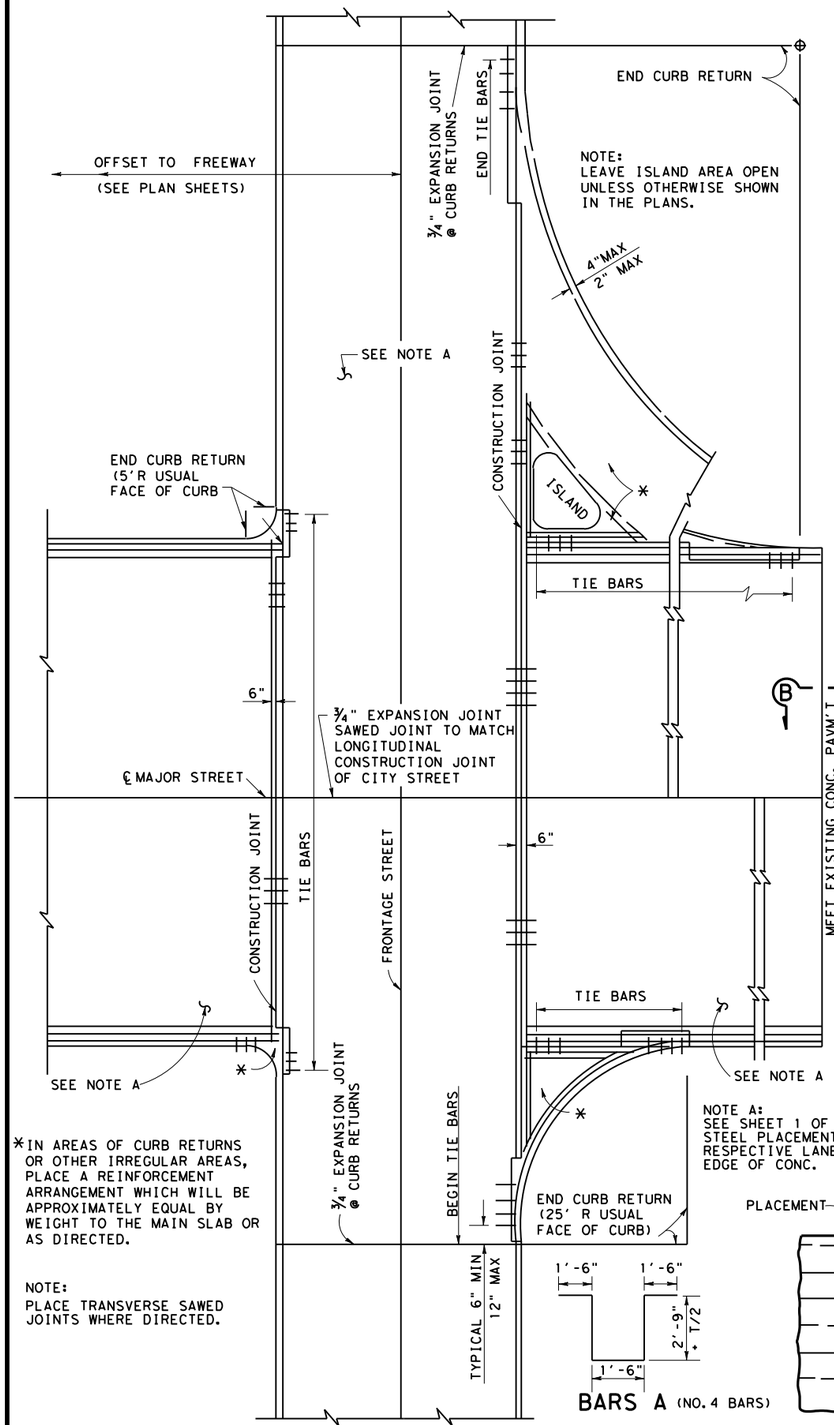
Texas Department of Transportation
Houston District

JOINTED REINFORCED CONCRETE PAVEMENT DETAILS

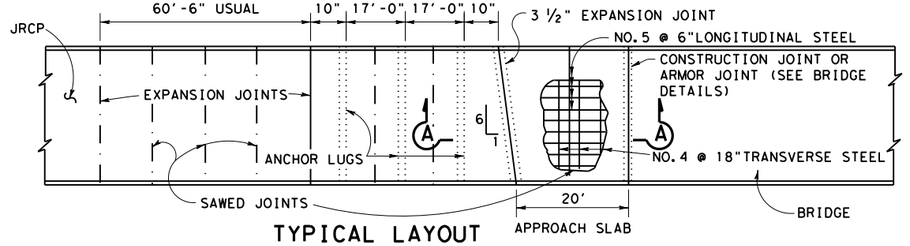
(FOR PAVEMENT THICKNESS 10 INCHES OR LESS)

JRCP SHEET 1 OF 2

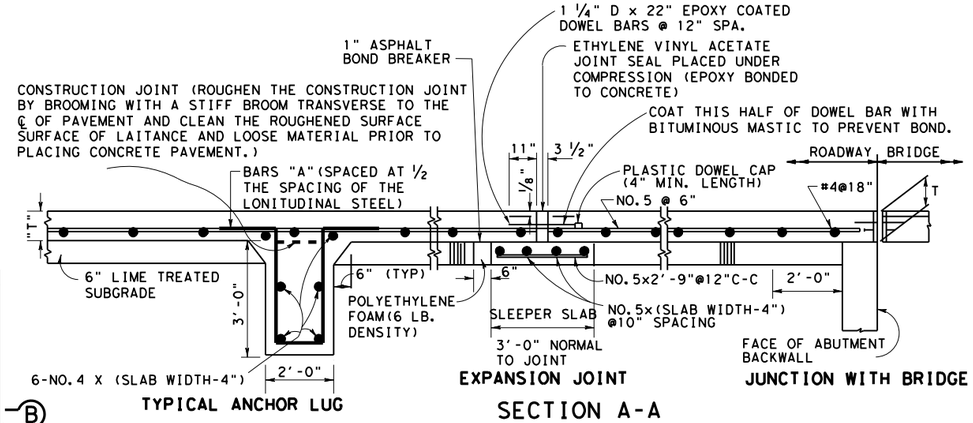
FILE: STDB-2.dgn	DN:	CK:	DW:	CK:
©TxDOT MAR. 2004	DIST	FED REG	PROJECT NO.	SHEET
REVISIONS 5/05 2004 SPECS 7/10 ADDED NOTE 2/15 2014 SPECS	HOU	6		
	COUNTY	CONTROL	SECT	JOB	HIGHWAY



INTERSECTION OF MAJOR STREET WITH FRONTAGE STREET TYPICAL REINFORCING PLAN

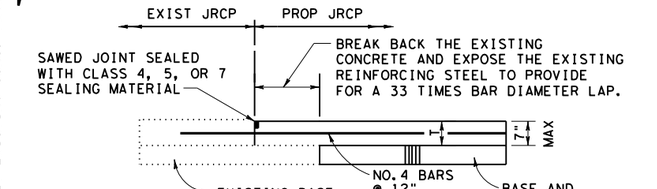


TYPICAL LAYOUT
(TERMINAL ANCHORAGE AT BRIDGES)



TYPICAL ANCHOR LUG | **EXPANSION JOINT** | **JUNCTION WITH BRIDGE**

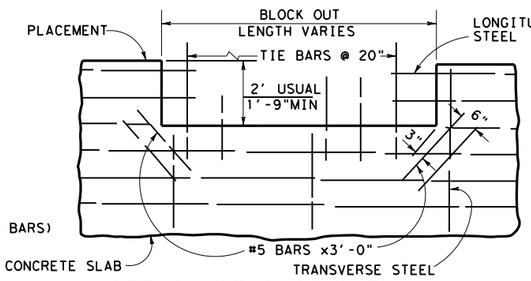
SECTION A-A



SECTION B-B
(FOR PROPOSED PAVEMENT DEPTHS OF 7" MAX)

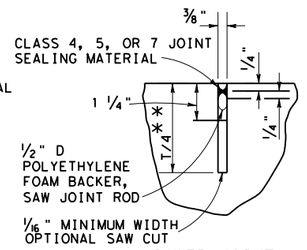
REPLACE ANY BENT LONGITUDNIAL REINFORCING. IF THERE IS NOT SUFFICIENT EXPOSED REINFORCING TO PROVIDE A MINIMUM OF A 33 TIMES BAR DIAMETER LAP, REMOVE THE EXISTING PAVEMENT AND SUFFICIENTLY EXPOSE THE EXISTING REINFORCING TO PROVIDE A 33 TIMES BAR DIAMETER LAP. REPLACE ANY SHEAR BARS THAT ARE DISTURBED, BY DRILLING AND GROUTING AS REQUIRED BY NOTE #29. PERFORM THIS CORRECTIVE ACTION AT NO EXPENSE TO THE DEPARTMENT.

NOTE A:
SEE SHEET 1 OF 2 FOR STEEL PLACEMENT FOR THE RESPECTIVE LANE WIDTHS. EDGE OF CONC.

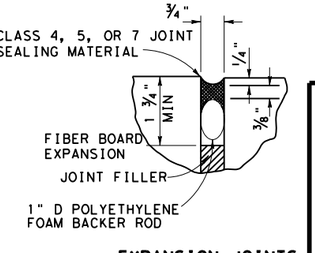


DETAIL OF BLOCKOUT

*OMIT TIE BARS @ INLET BLOCK-OUT



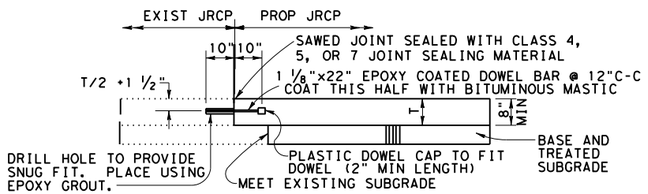
SAWED JOINT



EXPANSION JOINTS

** IF SILICEOUS RIVER GRAVEL IS USED AS THE COARSE AGGREGATE, THIS DEPTH IS T/3.

JOINT SEALING DETAILS



SECTION B-B
(FOR PROPOSED PAVEMENT DEPTHS OF 8" MIN)

GENERAL NOTES (CONTINUED FROM SHEET 1 OF 2)

21. CONSTRUCT ANCHOR LUGS, EXPANSION JOINTS, AND SLEEPER SLABS AS DETAILED IN SECTION A-A. THESE WILL BE PAID FOR IN ACCORDANCE WITH ITEM, "CONCRETE PAVEMENT TERMINALS."
22. REINFORCING STEEL FOR TERMINAL ANCHOR SYSTEMS MAY BE GRADE 40 OR GRADE 60.
23. PLACE CONCRETE FOR ANCHOR LUGS AS SOON AS POSSIBLE AFTER COMPLETING EXCAVATION, TO PRESERVE THE INHERENT SOIL CHARACTERISTICS. EXCAVATING FOR AND PLACING CONCRETE FOR ANCHOR SYSTEM MAY BE IN PREFORMED SECTIONS CORRESPONDING TO THE WIDTH OF PAVING PLACEMENT.
24. APPLY A STEEL TROWEL FINISH TO SLEEPER SLABS AND AND COAT WITH AN ASPHALT BOND BREAKER.
25. THE DETAILS FOR ANCHORS, LUGS, EXPANSION JOINTS, AND SLEEPER SLABS ARE NOT APPLICABLE UNLESS SHOWN ELSEWHERE IN THE PLANS.
26. APPROACH SLAB WILL BE PAID FOR IN ACCORDANCE WITH THE ITEM "CONCRETE STRUCTURES."
27. WITHIN 5 MINUTES OF SAWING, COMPLETELY REMOVE THE RESULTING SLURRY FROM THE JOINT BY FLUSHING WITH HIGH PRESSURE WATER. THEN ALLOW THE JOINT TO DRY FOR A MINIMUM OF 48 HOURS BEFORE SANDBLASTING THE JOINT.
28. DO NOT SHEAR CUT DOWEL BARS.
29. SIZE ADDITIONAL SHEAR BARS AS LONGITUDIAL BARS AND SPACE THEM MIDWAY BETWEEN ALTERNATE LONGITUDINAL BARS ALONG THE TRANSVERSE CONSTRUCTION JOINT FORMED AT THE LEAVE-OUT.
30. IF THE CONCRETE DESIGN REQUIRES GREATER THAN 5.5 SACKS OF CEMENTITIOUS MATERIAL PER CUBIC YARD, WRITTEN APPROVAL BY THE AREA ENGINEER WILL BE REQUIRED. ENSURE CONCRETE PAVEMENT MIXES PLACED FROM APRIL 1 TO OCTOBER 31 CONTAIN A MINIMUM OF 25 PERCENT BY WEIGHT OF CLASS "F" FLY ASH.
31. IN LOCATIONS WHERE THE PLANS CALL FOR FAST TRACK CONCRETE PAVEMENT IN LIEU OF JRCP (LAID ON COMPACTED OR STABILIZED SUBGRADE), USE DETAILS IN THIS STANDARD IN CONJUNCTION WITH THE APPROPRIATE FAST TRACK CONCRETE SPECIFICATION. IF THE JRCP IS LAID UPON A BASE STRUCTURE, ADD 3" TO THE FAST TRACK PAVEMENT THICKNESS TO COMPENSATE FOR THE BASE.

Texas Department of Transportation
Houston District

JOINTED REINFORCED CONCRETE PAVEMENT DETAILS
EXPANSION JOINT DESIGN
(FOR PAVEMENT THICKNESS 10 INCHES OR LESS)

JRCP SHEET 2 OF 2

FILE: STDB-2.dgn	DN:	CK:	DW:	CK:
© TxDOT MAR. 2004	DIST	FED REG	PROJECT NO.	SHEET
REVISIONS 5/05 2004 SPECS 7/2010 ADDED NOTE 9/2013 ADDED NOTE	HOU	6		
	COUNTY	CONTROL	SECT	JOB	HIGHWAY

SECTION 01 10 00

SUMMARY

PART 1 - GENERAL

1.1 PROJECT IDENTIFICATION

TEXAS DEPARTMENT OF TRANSPORTATION
Dallas District (18), COLLIN COUNTY
Engineering and Maintenance Facility:
2205 TX-5
McKinney, Texas 75069

1.2 CONTRACT DESCRIPTION

A. Hazardous removal from buildings, demolition and removal of on-site buildings, site preparation, building construction as shown in the plans: not limited to spaces for office, vehicle shops, material testing labs, truck wash, equipment shed, and fuel pads for above-ground tanks.

B. Perform Work of Contract under Lump Sum Total cost contract with Owner in accordance with Conditions of Contract.

1.3 PHASING AND SCHEDULING

A. Owner shall be vacated from all buildings to have asbestos abatement and demolition prior to construction.

B. Owner will be on site in phase 2 construction area while the contractor is constructing phase 1.

C. When construction is complete in phase 1 area. Owner shall move into and start to vacate temporary buildings in phase 2 area. Owner shall coordinate and remove all phase 2 buildings.

D. When phase 2 buildings are removed and when the other entry drives are able to be used by owner the contractor may proceed with phase 2 work which will include the installation of a 3rd secure entry gate, and site work.

E. After award of contract the contractor shall be prepared with a schedule of work in accordance with specification 01 32 16 that will include all phasing for work to be complete in contract period.

1.4 WORK BY OWNER

A. Owner will subcontract with an independent soil remediation team to remove contaminated soil as indicated on civil demolition plans. Contractor shall coordinate with owner during this scope of work.

B. Concurrent work by Owner or others: Owner reserves the right to conduct minor work with his own forces or separate contractors during the construction. Work will be coordinated with the contractor along the general demarcation line shown on the civil drawings.

1.5 OWNER SUPPLIED PRODUCTS

A. Owner will arrange for and deliver Owner-furnished items.

B. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.

C. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.

D. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.

E. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.

F. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them.

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Access to Site: Contractor will have unrestricted access to site. Contractor shall have full use of premises for construction operations, including use of Project site, during construction period. Contractor's use of premises is limited only by Owner's right to perform work or to retain other contractors on portions of Project.

1.7 SPECIFICATION CONVENTIONS

A. These specifications are written in imperative mood and streamlined form. This imperative language is directed to the Contractor, unless specifically noted otherwise. The words “shall be” are included by inference where a colon (:) is used within sentences or phrases. Except where specifically intended otherwise, the subject of all imperative statements is the Contractor. For example, 'Provide tile' means 'Contractor shall provide tile.'

1.8 CONTRACTOR

A. Permits and Fees: Apply for, obtain, and pay for permits, if applicable, fees, and utility company back charges required to perform the work. Contractor is responsible for contacting the local service providers (municipality, water, electric, and communications). Refer to plans for additional information. All inspections at site will be conducted by TxDOT staff.

B. Codes: Comply with applicable codes and regulations indicated on coversheet of Construction Drawings. Submit copies of inspection reports, notices and similar communications to Owner.

C. Dimensions: Verify dimensions indicated on drawings with field dimensions before fabrication or ordering of materials. **Do not scale drawings.**

D. Existing Conditions: Notify Owner of existing conditions differing from those indicated on the drawings. Do not remove or alter structural components without prior written approval of the Architect.

E. Coordination:
1. Coordinate the work of all trades.
2. Prepare coordination drawings for areas above ceilings where close tolerances are required between building elements and mechanical and electrical work.
3. Verify location of utilities and existing conditions prior to beginning work.

F. Installation Requirements, General:
1. Inspect substrates and report unsatisfactory conditions in writing.
2. Do not proceed until unsatisfactory conditions have been corrected.
3. Take field measurements prior to fabrication where practical. Form to required shapes and sizes with true edges, lines and angles. Provide inserts and templates as needed for work of other trades.
4. Install materials in accordance with Manufacturer's instructions and approved submittals.
5. Install materials in proper relation with adjacent construction and with proper appearance.
6. Restore units damaged during installation. Replace units which cannot be restored at no additional expense to the Owner.
7. Refer to additional installation requirements and tolerances specified under individual specification sections.

G. Definitions:
1. Provide: Furnish and install, complete with all necessary accessories, ready for intended use. Pay for all related costs.
2. Reviewed: Review of items submitted. Not a limitation or release for compliance with the Contract Documents or regulatory requirements. Refer to limitations of 'Reviewed' in General and Supplementary Conditions.

H. Intent: Drawings and specifications are intended to provide the basis for proper completion of the work suitable for the intended use. Anything not expressly set forth but which is reasonable implied or necessary for proper performance of the project shall be included.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SCHEDULE OF VALUES

A. Submit printed schedule on Owner provide form or electronic media.

B. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
   1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with Continuation Sheets
      b. Submittals Schedule
      c. Contractor's Construction Schedule
   2. Submit the Schedule of Values to the Architect in duplicate no later than seven days before the date scheduled for submittal of initial Applications for Payment.

C. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section. Identify separately site mobilization, bonds and insurance, and a breakdown of the General Contractors general conditions.
   1. Identification: Include the following Project identification on the Schedule of Values:
      a. Project name and location
      b. Name of Architect
      c. TxDOT project number
      d. Contractor's name and address
      e. Date of submittal
   2. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division
      b. Description of the Work
      c. Change Orders (numbers) that affect value
      d. Allowances (numbers) per bid proposal
      e. Dollar value
         1) Percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent
   3. Provide a breakdown of the Contract Sum (labor & materials) in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate.
   4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
   5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.

6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Provide separate line items in the Schedule of Values for each Allowance per bid proposal.
8. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
   a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
9. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.
10. Provide any additional information as set forth in the UGC.

1.2 APPLICATIONS FOR PAYMENT

A. Submit two copies of each application to Architect for review, 7 days prior to Payment Application Time.

B. Each monthly Application for Payment shall be consistent with previous applications and payments as certified by Architect, TxDOT Project Manager, TxDOT District Representative and paid for by Owner.
   1. Initial Application for Payment, Application for Payment at Substantial Completion, and final Application for Payment require additional documentation.

C. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.

D. Payment Application Forms: Use forms provided by TxDOT for Applications for Payment.

E. Application Preparation: Complete every entry on form. Architect and TxDOT Project Manager will return incomplete applications without action.
   1. Entries shall match data on the Schedule of Values. Use updated schedule if revisions were made.
   2. Include amounts of Change Orders approved before last day of construction period covered by application.
   3. Submit Contractor’s Affidavit of Payment of Debts and Claims – Monthly Progress Payment
   4. Submit HUB Subcontracting Plan (HSP) Prime Contractor Progress Assessment Report.
   5. Submit updated two construction schedules with each Application for Payment.

F. Transmittal: Submit 5 signed original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors
2. Schedule of Values
3. Contractor's Construction Schedule
4. Products list
5. Schedule of unit prices
6. Submittals Schedule
7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
   1. Updated final statement, accounting for final changes to the Contract Sum
   2. Owner provided document , "Contractor's Affidavit of Payment of Debts and Claims –Final Payment"
   3. Owner provided document, "Consent of Surety to Final Payment"
   4. Evidence that claims have been settled
   5. Final liquidated damages settlement statement if applicable.
   6. HUB Subcontracting Plan (HSP) Prime Contractor Progress Assessment Report.
   7. Buy America form D-9-USA 1 or it equivalent.
   8. If required, a close-out Change Order.
   9. Provide any additional information as set forth in UGC.

J. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:

   1. Affidavits attesting to off-site stored products.
   2. Construction progress schedules, revised and current.

1.3 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. The Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions.

C. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within 10 days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    b. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
    c. Include costs of labor and supervision directly attributable to the change.
    d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

D. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.
1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Use TxDOT approved Proposal Requests.
    a. Document each quotation for change in cost or time with sufficient data to allow evaluation of quotation.

1.4 CHANGE ORDER PROCEDURES

A. On approval of a Proposal Request, Owner will issue a Change Order for signatures of Contractor and Architect on Owner’s appropriate form.
1. Execution of Change Orders: Owner shall issue Change Orders for signatures of parties as provided in Conditions of the Contract.

B. 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 revise progress schedules to reflect change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
3. Promptly enter changes in Project Record Documents.

1.5 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

B. If, in the opinion of the Architect/Engineer, it is not practical to remove and replace the Work, the Architect/Engineer and/or Owner will direct appropriate remedy or adjust payment.

C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer and/or Owner.

D. Defective Work will be partially repaired to instructions of Architect/Engineer and/or Owner and unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer and /or Owner.

E. Individual specification sections may modify these options or may identify specific formula or percentage sum/price reduction.

F. Authority of Architect/Engineer and/or Owner to assess defects and identify payment adjustments is final.

G. Non-Payment For Rejected Products: Payment will not be made for rejected products for any of the following:
   1. Products wasted or disposed of in a manner that is not acceptable.
   2. Products determined as unacceptable before or after placement.
   3. Products not completely unloaded from transporting vehicle.
   4. Products placed beyond lines and levels of required Work.
   5. Products remaining on hand after completion of the Work.
   6. Loading, hauling, and disposing of rejected products.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 25 00

SUBSTITUTION AND PRODUCT OPTIONS

PART 1 GENERAL

1.1 PRODUCT LIST:

A. Within 30 days after date of Contract, submit to Architect 5 copies of complete list of products and materials which are proposed for installation.

B. Prepare list on basis of each Specification section.

C. For products specified under reference standards, include with listing of each product:
   1. Name and address of manufacturer.
   2. Trade name.
   3. Model or catalog designation.
   4. Manufacturer's data, including performance and test data, reference standards.

1.2 CONTRACTOR'S OPTIONS:

A. For products specified only by reference standards, select any product meeting standards, by any manufacturer.

B. For products specified by naming several products or manufacturers, select any product and manufacturer named.

C. For products specified by naming only one product and manufacturer, there is no option, unless a substitution is approved as specified below.

1.3 SUBSTITUTIONS:

A. During Bidding, no substitution requests will be considered.

B. Within 30 days after date of Contract, Architect will consider formal requests from Contractor for substitutions of products in place of those specified. No request for substitutions will be considered after this date.

C. Submit an electronic copy of request for substitution. Include in substitution:
   1. Data substantiating compliance of proposed substitution with Contract documents.
   2. For products:
      a. Product identification, including manufacturer’s name and address.
      b. Manufacturer’s literature, including product description, performance and test data and reference standards.
      c. Samples, if applicable.
      d. Name and address of similar projects on which product was used and date of installation.

3. For construction methods:
   a. Detailed written descriptions of proposed method.
   b. Complete drawings illustrating methods or revisions.
4. Itemized comparison of proposed substitution with product or method specified.
5. Data relating to changes in construction schedule.

D. In making request for substitution, Bidder/Contractor represents:
1. He has personally investigated proposed product or method and determined that it is equal or superior in all respects to that specified.
2. He will provide same guarantee for substitution as for product or method specified.
3. He will coordinate installation of accepted substitution into work, making such changes as may be required for work to be complete in all respects.
4. He waives all claims for additional costs related to substitution which subsequently becomes apparent

E. Substitutions will not be considered if:
1. They are indicated or implied on show drawings or product data submittals without formal request as submitted in accordance with *Article 1.3* of this Section.
2. Acceptance will require substantial revision of Contract Documents.

PART 2 PRODUCTS

2.1 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 30 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements.
1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor's Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

SUBSTITUTION REQUEST

PROJECT: _____ PROJECT NO.: _____

TO: TxDOT Construction Project Manager FROM: CONTRACTOR/BIDDER

_____ _____

_____ _____

CONTRACTOR (BIDDER) HEREBY REQUESTS ACCEPTANCE OF THE FOLLOWING PRODUCT OR SYSTEMS AS A SUBSTITUTION IN ACCORD WITH PROVISIONS OF DIVISION ONE OF THE SPECIFICATIONS:

1. SPECIFIED PRODUCT OR SYSTEM:
   Substitution request for (Generic Description): _____

   Specification Section No.: _____ Article(s) _____ Paragraph (s) _____

2. SUPPORTING DATA:
   Product data for proposed substitution is attached (description of product, reference standards, performance and test data).

   Sample is attached Sample will be sent if requested

3. QUALITY COMPARISON:

	SPECIFIED PRODUCT	SUBSTITUTION
Name brand:	_____	_____
Catalog No.	_____	_____
Manufacturer:	_____	_____
Vendor:	_____	_____
Significant Variations:	_____	_____
	_____	_____

Maintenance Service Available: _____ Yes _____ No

Spare Part Source: _____

4. PREVIOUS INSTALLATIONS:
   Identification of similar projects on which proposed substitution was used:

   Project: _____ Architect: _____

   Address: _____ Owner: _____

   _____ Date Installed: _____

   _____

5. REASON FOR NOT GIVING PRIORITY TO SPECIFIED ITEMS:

   _____

   _____

6. EFFECT OF SUBSTITUTION:
   Proposed substitution affects other parts of Work: _____ No _____Yes (If yes, explain)

_____

_____

Substitution changes Contract Time: _____ No _____ Yes Add/Deduct _____days.

Substitution requires dimensional revision or redesign of structure or M & E Work:

_____ No _____ Yes (If yes, attach compete data)

Saving or credit to Owner, if any, for accepting substitution: $_____.

Extra cost to Owner, if any, for accepting substitution: $_____.

7. CONTRACTOR'S (BIDDER'S) STATEMENT OF CONFORMANCE OF PROPOSED SUBSTITUTION TO CONTRACT REQUIREMENT:

   I/we:
   ___ have investigated the proposed substitution.
   ___ believe that it is equal or superior in all respects to specified product, except as stated above.
   ___ will provide the same warranty as specified for specified product.
   ___ have included complete cost data and implications of the substitution.
   ___ will pay redesign and special inspection costs caused by the use of this product.
   ___ will pay additional costs to other contractors caused by the substitution.
   ___ will coordinate the incorporation of the proposed substitution in the Work.
   ___ will modify other parts of the work as needed, to make all the work complete and functioning.
   ___ waive future claims for added cost to Contract caused by the substitution.

Contractor (Bidder): _____ Date: _____

By: _____

Answer all questions and complete all blanks - use "N/A" if not applicable.

ARCHITECT REVIEW AND ACTION

___ Resubmit substitution request:

___ Provide more information in following categories.

_____

___ Sign Contractor's (Bidder's) Statement of Conformance.

___ Substitution accepted.

___ Substitution is accepted with the following comments.

_____

_____

___ Substitution not accepted.

___ Substitution Request received too late.

_____ _____

Architect / Engineer of Record Date

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 - GENERAL

1.1 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. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Provide project superintendent and other supervisory personnel required for proper performance of the work.
2. Submit list of subcontractors' names, phone numbers and trade work.
3. Participate in a pre-construction meeting at a time and place determined by the Owner for the purpose of identifying responsibilities of the Owner's and Architect's personnel and explanation of administrative procedures.
4. Schedule and conduct monthly meetings, distribute meeting Minutes.
5. Schedule and conduct other meetings as necessary, distribute meeting Minutes.
6. Owner to schedule and conduct other meetings as necessary, the Owner will distribute meeting Minutes.
7. Preparation of Contractor's Construction Schedule.
8. Preparation of the Schedule of Values.
9. Installation and removal of temporary facilities and controls.
10. Preparation of the Submittal Review Schedule.
11. Delivery and processing of submittals.
12. Progress meetings.
13. Preinstallation conferences.
14. Project closeout activities.
15. Startup and adjustment of systems.
16. Project closeout activities.
17. Submit bar chart progress schedule, updated monthly.
18. Prepare submittal schedule coordinated with progress schedule.
19. Submit schedule of values, divided so as to facilitate payments to subcontractors, on forms acceptable to the Owner. Schedule, when approved, will be used as the basis for the Contractor's Application for payment.
20. Submit schedule of required tests.
21. Perform all field engineering, layout, and surveying required for layout of project.
22. Submit and post a list of emergency telephone numbers and addresses for individuals to be contacted in case of emergency.
23. Record drawings and specifications to be maintained and annotated by contractor as work progresses to record actual construction, and be turned over to the

Architect at substantial completion. See Section 01 70 00 for detailed requirements.

24. Submit payment request procedures.
25. Perform quality control during installation.
26. Clean and protect the work.

C. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

D. 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.

E. 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.

F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion and for portions of Work designated for Owner's partial occupancy.

H. After Owner occupies the premises any access to complete remaining Work or correct defective Work must be coordinated with the Owner's representative in order to minimize disruption of Owner's activities.

1.2 CONSTRUCTION LAYOUT

A. The General Contractor shall include in his bid the cost for providing all construction staking by a Registered Public Surveyor (Surveyor) licensed by Texas Board of Professional Land Surveyors who can demonstrate experience and competence to perform the work described. The grades, spot elevations, dimensions radii, flow line elevations, existing bench marks, excavation and site grading will be indicated on the plans. In the event that discrepancies are noted in the plans by the Contractor and/or the Surveyor, the Architect and/or Engineer of Record shall be notified and the discrepancies shall be resolved prior to proceeding with the Work. The Surveyor shall supervise the layout work and establish at least three (3) separate permanent bench marks, to which easy access may be had during the progress of the work, to determine and verify lines and grades.

B. Under the supervision of the Surveyor, the layout of the work shall be made from the surveyor-established base lines, utility alignments, curb faces, key trees, bench marks and all other control lines as indicated on the plans; and the Contractor shall be

responsible for all measurements in connection therewith as specified and as indicated on the plans.

C. Contractor shall be responsible for having the Surveyor **verify that elevations of form work.** The Surveyor shall return a second time to **verify site grading, sidewalk elevations, rough grading next to buildings, concrete curb elevations, base material elevations prior to paving.** All surveying work shall comply with the elevations, lines and grades shown on the plans and **provide a written report and large size (22" x 34") drawings indicating findings** to the Architect and/or Engineer of Record for consideration and response prior to placing concrete, placing asphalt or install landscaping. Contractor shall not proceed further without Surveyor's Report / Drawings and the contractor shall be responsible for making the required corrections prior to continuing the Work. No extra charge or compensations will be allowed due to differences between actual dimensions and the measurements indicated on the drawings.

D. Employ Land Surveyor registered and acceptable to the Owner.

E. Locate and protect survey control and reference points. Promptly notify Architect/Engineer of discrepancies discovered.

F. Control datum for survey is that established by Owner provided survey.

G. Verify set-backs and easements; confirm drawing dimensions and elevations.

H. Provide field engineering services. Establish elevations, lines, and levels, utilizing recognized engineering survey practices.

I. Submit copy of site drawing signed by Land Surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.

J. Maintain complete and accurate log of control and survey work as Work progresses.

K. Protect survey control points prior to starting site work; preserve permanent reference points during construction.

L. Promptly report to Architect/Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.

M. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

1.3 PRECONSTRUCTION MEETING

A. The Owner's Representative will schedule a pre-construction conference and organizational meeting at the Project Site or other convenient location after execution of the Agreement and prior to commencement of construction activities. The Owner's Representative will conduct the meeting to review responsibilities and personnel assignments.

B. Attendees shall include: The Owner, Architect/Engineer and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the Work.

C. The Agenda shall: Discuss items of significance that could affect progress including such topics as:
1. Tentative construction schedule
2. Critical Work sequencing
3. Designation of responsible personnel
4. List of Subcontractors, trade work, names and phone numbers
5. Procedures for processing field decisions and Change Orders
6. Procedures for processing Applications for Payment
7. Distribution of Contract Documents
8. Submittal of Shop Drawings, Product Data and Samples
9. Preparation of record documents
10. Use of the premises
11. Office, Work and storage areas
12. Equipment deliveries and priorities
13. Safety procedures
14. First Aid
15. Security
16. Housekeeping
17. Working hours

D. The Owner's Representative will record Minutes and distribute copies within five days after meeting to participants, with copies to contractor and those affected by decisions made.
1. General Contractor will distribute Minutes to others.

1.4 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at maximum bi-weekly intervals.
1. Coordinate dates of meetings with Architect and TxDOT Inspector.
2. Prepare Contractor's Application for Payment (CAP) on TxDOT form. Architect shall provide forms required for payment submittal.

B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Job superintendent, major subcontractors and suppliers, Owner, Architect/Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review of 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. Other business relating to Work

E. Record Minutes and distribute copies within three days after meeting to participants, with copies to Architect/Engineer, Owner, and those affected by decisions made.

1.5 PRE-INSTALLATION 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 Architect/Engineer and Owner 14 days in advance of meeting date.

D. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.
   a. Contract documents
   b. Options
   c. Related Change Orders
   d. Purchases
   e. Deliveries
   f. Shop Drawings, Product Data and Quality Control Samples
   g. Possible Conflicts
   h. Compatibility Problems
   i. Time Schedules
   j. Weather Limitations
   k. Manufacturer's Recommendations
   l. Compatibility of Materials
   m. Acceptability of Substrates
   n. Temporary Facilities
   o. Space and Access Limitations
   p. Governing Regulations
   q. Safety
   r. Inspection and Testing Requirements
   s. Recording Requirements
   t. Protection

E. Record Minutes and distribute copies within three days after meeting to participants, with copies to Architect/Engineer, Owner, and those affected by decisions made.

1. Do not proceed if the conference cannot be successfully concluded.
2. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.6 COORDINATION MEETINGS

A. Conduct project coordination meetings at regularly scheduled times convenient for all parties involved. Project Coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and specific pre-installation conferences.

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

C. Record meeting decisions or action and distribute copies to everyone in attendance and to others affected by those decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 32 16

CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work.

1.2 SUBMITTALS

A. Submittals Schedule: Submit an electronic file in MS Office Project. Arrange the following information in a tabular format:
   1. Scheduled date for first submittal
   2. Specification Section number and title
   3. Submittal category (action or informational)
   4. Name of subcontractor
   5. Description of the Work covered
   6. Scheduled date for Architect's final release or approval

B. Contractor's Construction Schedule: Submit an electronic copy of the initial schedule, large enough to show entire schedule for entire construction period.

C. CPM Reports: Concurrent with CPM schedule, submit an electronic copy of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
   1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
   2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
   3. Total Float Report: List of all activities sorted in ascending order of total float.
   4. Earnings Report: Compilation of Contractor's total earnings from the Notice to Proceed until most recent Application for Payment.

D. Daily Construction Reports: Submit an electronic copy at monthly intervals, when requested.

E. Field Condition Reports: Submit an electronic copy at time of discovery of differing conditions.

F. Special Reports: Submit an electronic copy at time of unusual event.

1.3 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
   1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
   2. If a Preliminary Construction Schedule is not required, delete subparagraph below or revise to require initial submittal within 14 days of date established for commencement of the Work.
   3. Delete subparagraph below if not allowed.
   4. Revise subparagraph below if schedule must be continuously updated to reflect current status and changes in timing for submittals.
   5. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Procedures: Comply with procedures contained in AGC's "Construction Planning & Scheduling."

B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of Substantial Completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.

3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
4. Startup and Testing Time: Include not less than seven days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and TxDOT Project Manager administrative procedures necessary for certification of Substantial Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
2. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 1 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
4. Work Restrictions: Show the effect of the following items on the schedule:
    a. Seasonal variations
    b. Environmental control
5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    a. Submittals
    b. Mockups
    c. Fabrication
    d. Sample testing
    e. Deliveries
    f. Installation
    g. Tests and inspections
    h. Adjusting
    i. Curing
    j. Startup and placement into final use and operation
6. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    a. Structural completion
    b. Permanent space enclosure
    c. Completion of mechanical installation
    d. Completion of electrical installation
    e. Substantial Completion

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
First paragraph below establishes progress measured in dollar volume of the Work.

F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
   1. Refer to Division 1 Section "Payment Procedures" for cost reporting and payment procedures.
   2. Retain three subparagraphs below for CPM schedule.
   3. Contractor shall assign cost to construction activities on the CPM schedule. Costs shall not be assigned to submittal activities unless specified otherwise but may, with Architect's approval, be assigned to fabrication and delivery activities. Costs shall be under required principal subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
   4. Each activity cost shall reflect an accurate value subject to approval by Architect.
   5. Total cost assigned to activities shall equal the total Contract Sum.

G. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Projects using CPM schedules should begin with a preliminary network diagram of type described below or a preliminary bar-chart schedule.

C. Preliminary Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

D. Revise paragraph and subparagraphs below to suit Project.

E. CPM Schedule: Prepare Contractor's Construction Schedule using a computerized, time-scaled CPM network analysis diagram for the Work.
   1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 14 days after date established for the Notice to Proceed.
      a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
   2. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
   3. Use "one workday" as the unit of time. Include list of nonworking days and holidays incorporated into the schedule.

F. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.
   1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
      a. Preparation and processing of submittals
      b. Mobilization and demobilization
      c. Purchase of materials
      d. Delivery
      e. Fabrication
      f. Installation
      g. Testing
   2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
   3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
   4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
      a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

G. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
   1. Contractor or subcontractor and the Work or activity
   2. Description of activity
   3. Principal events of activity
   4. Immediate preceding and succeeding activities
   5. Early and late start dates
   6. Early and late finish dates
   7. Activity duration in workdays
   8. Total float or slack time
   9. Average size of workforce
   10. Dollar value of activity (coordinated with the Schedule of Values)

H. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
   1. Identification of activities that have changed
   2. Changes in early and late start dates
   3. Changes in early and late finish dates
   4. Changes in activity durations in workdays
   5. Changes in the critical path
   6. Changes in total float or slack time
   7. Changes in the Contract Time

2.4 REPORTS

A. Daily Construction Reports: Maintain a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site
   2. Approximate count of personnel at Project site
   3. Material deliveries
   4. High and low temperatures and general weather conditions
   5. Accidents
   6. Meetings and significant decisions
   7. Unusual events (refer to special reports)
   8. Stoppages, delays, shortages, and losses
   9. Emergency procedures
   10. Orders and requests of authorities having jurisdiction
   11. Change Orders received and implemented
   12. Proposed Construction Change Directives
   13. Construction Change Directives received and implemented
   14. Services connected and disconnected
   15. Equipment or system tests and startups
   16. Substantial Completions authorized

B. Field Condition Reports: Have field reports available for review by owner.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
   1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
   2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
   3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
   1. Post copies in Project meeting rooms and temporary field offices.
   2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

C. Distribution: Provide electronic copy to Architect in MS Office Project format.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
   2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
      a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
   1. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 15 days for review of each resubmittal.
   4. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 21 days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.
   5. Schedule submissions at least 40 days before reviewed submittals will be needed, in accordance with the above review times noted above (the above allows for one resubmittal review and distribution) and approved submittal schedule.

D. Insert list of submittals below allowing concurrent review or delete and identify submittals in Sections where they are specified. Structural, mechanical, plumbing, and electrical components are examples of the Work that often require simultaneous transmittal to Architect and consultants.

E. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.
   1. Coordinate each submittal with requirements of work of Contract Documents.
   2. Contractor's responsibility for errors and omissions in submittals is not relieved by Architect's review of submittals.
   3. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by Architect's review of submittals, unless Architect gives written acceptance of specific deviations.
   4. Notify Architect, in writing at time of submission, of deviations in submittals from requirements of Contract Documents.

F. Identification: Place a permanent label or title block on each submittal for identification.
   1. Indicate name of firm or entity that prepared each submittal on label or title block.
   2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
   3. Include the following information on label for processing and recording action taken:
      a. Project name
      b. Date
      c. Name and address of Architect
      d. Name and address of Contractor
      e. Name and address of Subcontractor
      f. Name and address of Supplier
      g. Name of Manufacturer
      h. Submittal number
      i. Number and title of appropriate Specification Section
      j. Drawing number and detail references, as appropriate
      k. Location(s) where product is to be installed, as appropriate
      l. Other necessary identification

G. Deviations: Highlight, encircle, or otherwise specifically identify deviations from the Contract Documents on submittals.

H. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
   1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
   2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.

I. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
   1. Transmittal Form: Use form acceptable to the Owner and Architect. Provide locations on form for the following information:
      a. Project name

b. Date
c. Destination (To)
d. Source (from)
e. Names of Subcontractor, Manufacturer, and Supplier
f. Category and type of submittal
g. Submittal purpose and description
h. Specification Section number and title
i. Drawing number and detail references
j. Transmittal number, numbered consecutively
k. Submittal and transmittal distribution record
l. Remarks
m. Signature of Transmitter

2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same label information as related submittal.

J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. When revised for resubmission, identify changes made since previous submission.
2. Mark revised submittals with original number and sequential alphabetic suffix. Note date and content of previous submittal.
3. Note date and content of revision in label or title block and clearly indicate extent of revision.

K. Allow space on submittals for Contractor and Architect/Engineer review stamps.

L. Resubmit submittals until they are marked ‘REVIEWED’.

M. Distribution: Furnish copies of final submittals to Manufacturers, Subcontractors, Suppliers, Fabricators, Installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
1. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

N. Use for Construction: Use only final submittals with mark indicating ‘REVIEWED’.
1. Begin no work which requires submittals until return of submittals with Architect’s stamp and initials or signature indicating review.

O. Submittals not requested will not be recognized or processed.

1.2 CONSTRUCTION PROGRESS SCHEDULES

A. Submit preliminary outline Schedules within 15 days after date of Owner-Contractor Agreement for coordination with Owner's requirements. After review, submit detailed schedules within 7 days modified to accommodate revisions recommended by Architect/Engineer and Owner.

B. Related Section 01 32 16 – Construction Progress Schedule: Submit revised Progress Schedules with each Application for Payment.

C. Distribute copies of reviewed schedules to Project site file, Subcontractors, Suppliers, and other concerned parties.

D. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

E. Submit computer generated horizontal bar chart or other approved form with separate line for each section of Work, identifying first work day of each week.

F. Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate early and late start, early and late finish, float dates, and duration.

G. Indicate estimated percentage of completion for each item of Work at each submission.

H. Submit separate schedule of submittal dates for shop drawings, product data, and samples, including Owner furnished products and products identified under Allowances, and dates reviewed submittals will be required from Architect/Engineer. Indicate decision dates for selection of finishes.

I. Indicate delivery dates for Owner furnished products and products identified under Allowances.

J. Revisions To Schedules:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
   2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.
   3. Prepare narrative report to define problem areas, anticipated delays, and impact on Schedule. Report corrective action taken, or proposed, and its effect including effect of changes on schedules of separate Contractors.

1.3 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Owner-Contractor Agreement, 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.

1.4 SUBCONTRACTOR LIST

A. Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, and telephone number of entity perform subcontract or supplying products
2. Number and title of related Specification Sections(s) cover by Subcontractor
3. Drawing number and detail references, as appropriate, covered by subcontract

B. Submit three copies of Subcontractor list, unless otherwise indicated. Architect will return two copies.
   1. Mark up and retain one returned copy as a Project Record Document.

1.5 PRODUCT DATA

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

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

C. Submit number three Contractor copies, plus two copies Architect/Engineer will retain.

D. Mark each copy to identify applicable products, models, options, and other data. Supplement Manufacturers' standard data to provide information specific to this Project.

E. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

F. Distribute copies after review.

1.6 SHOP DRAWINGS

A. Prior to submitting shop drawings, Contractor shall furnish Architect with complete Shop Drawing Submittal Log. No Submittals will be reviewed until a complete Submittal Log has been submitted to Architect.
   1. Contractor shall submit all required shop drawings and product data to the Architect with reasonable promptness and in an orderly sequence so as to cause no delay in the work.
   2. Prepare and submit, with construction schedule, a separate schedule listing dates for submission and lead dates for reviewed shop drawings, product data and samples for each item.
   3. No extension of time shall be allowed because of failure to properly coordinate and sequence submittals.

B. 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.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. Dimensions
   b. Identification of products
   c. Fabrication and installation drawings
   d. Roughing-in and setting diagrams
   e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
   f. Shopwork manufacturing instructions
   g. Templates and patterns
   h. Schedules
   i. Design calculations
   j. Compliance with specified standards
   k. Notation of coordination requirements
   l. Notation of dimensions established by field measurement
   m. Relationship to adjoining construction clearly indicated
   n. Seal and signature of professional engineer if specified
   o. Wiring Diagrams: Differentiate between Manufacturer-installed and field-installed wiring
2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 22 by 24 inches.
3. Number of Copies: Submit five opaque copies of each submittal, unless copies are required for operation and maintenance manuals. Architect will retain two copies; remainder will be returned. Mark up and retain one returned copy as a Project Record Drawing

D. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

E. All work must ultimately comply with the contract documents unless Architect/Engineer gives specific written acceptance of specific deviations.

F. Distribute copies after review.

1.7 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 Initial 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, textures, and patterns for Architect/Engineer selection.

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 two samples.
   1. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
   2. Retain one sample on construction site for field comparison as needed.

F. Samples will not be used for testing purposes unless specifically stated in specification section.

G. Distribute samples after review.

1.8 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.

1.9 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, start-up, 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 within 10 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 ERECTION DRAWINGS

A. Submit drawings for Architect/Engineer's benefit 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.

C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

1.14 PROJECT WARRANTY AND MAINTENANCE MANUAL:

A. Prior to final payment, the Contractor shall furnish two complete sets, in tabbed standard size ring binders, of equipment data, maintenance information, operations instructions, and warranties for equipment and systems provided under this contract. See Section 01700 for detailed requirements.

B. Provide warranties as specified. Warranties shall not limit length of time for remedy of damages Owner may have by legal statute. Contractor, Supplier, or Installer responsible for performance of warranty shall sign warranties.

C. Material Safety Data Sheets (MSDSs): Submit information directly to TxDOT.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

PART 4 - ARCHITECT'S/ACTION

4.1 General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.

A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken.

B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

C. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 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 fully with manufacturers' instructions, including each step in sequence and secure Manufacturers certification as certified installer, when applicable.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

D. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

E. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. Perform Work by persons qualified to produce required and specified quality. The Contractor shall comply with applicable local, state, and federal codes and regulations.
   1. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for or this Project, whose work has resulted in construction with a record of successful in-service performance.
   2. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
   3. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
   4. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.
   5. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual

Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

6. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
7. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
8. Factory-Authorized Service Representative Qualifications: An authorized representative of Manufacturer who is trained and approved by Manufacturer to inspect installation of Manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

G. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

H. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

I. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
   1. Access to the Work
   2. Incidental labor and facilities necessary to facilitate tests and inspections
   3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples
   4. Facilities for storage and field curing of test samples
   5. Delivery of samples to testing agencies
   6. Preliminary design mix proposed for use for material mixes that require control by testing agency
   7. Security and protection for samples and for testing and inspecting equipment at Project site

J. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
   1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.2 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.

1.3 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 for receiving bids, 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.

1.4 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.

1.5 MOCK-UP REQUIREMENTS

A. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
   2. Notify Architect 14 days in advance of dates and times when mockups will be constructed.
   3. Demonstrate the proposed range of aesthetic effects and workmanship.
   4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
   5. Allow seven days for initial review and each re-review of each mockup.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Architect/Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Architect/Engineer.

1.6 TESTING AND INSPECTION SERVICES

A. Refer to Specifications Section 01 40 10 – Testing Laboratory Services.

B. Employ and pay for services of an independent testing agency or laboratory acceptable to Owner to perform specified testing.

1. Prior to start of Work, submit testing laboratory name, address, and telephone number, and names of full time specialist and responsible officer.
2. Submit copy of report of laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of deficiencies reported by inspection.

C. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by Architect/Engineer and / or Owner.
   1. Laboratory: Authorized to operate at Project location.
   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. The work will be observed by the Architect/Engineer (Owner's Representative) or the Owners field observer and performed to his satisfaction in accordance with the Contract Plans and Specifications. The Owner's representative and Architect/Engineer will decide all questions which may arise as to the quality of acceptability of materials furnished and work performed; the manner of performance and rate of progress of the work; the interpretations of the contract plans and specifications; and the acceptable fulfillment of the contract on the part of the Contractor. The Owner's decisions will be final, and he will have executive authority to enforce and make effective such decisions and orders if the contractor fails to carry out the work promptly.

F. Reports will be submitted by independent firm to Architect/Engineer, TxDOT Project Manager (2 copies) and Contractor, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

G. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Architect/Engineer and independent firm 48 hours prior to expected time for operations requiring services.
   2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

H. Testing and employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

I. Re-testing 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 re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

J. Agency Responsibilities:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.

4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-conformance of Work or products.
6. Perform additional tests required by Architect/Engineer.
7. Attend preconstruction meetings and progress meetings.

K. Agency Reports: After each test, promptly submit two copies of report to Architect/Engineer and to Contractor. When requested by Architect/Engineer, provide interpretation of test results.

L. Limits On Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

M. Any materials and/or workmanship which are rejected by the Engineer by reason of failure to conform to the requirements of the plans or specifications shall be removed and replaced at Contractor's expense, including testing expense to correct faulty work.

N. Inspections and testing required by law, ordinances, rules and regulations or other public authorities are the responsibility of the Contractor. It is the sole responsibility of the Contractor to call for testing and any work not tested will be automatically rejected.

O. Contained in the various specification sections are requirements for certification of products, testing, adjusting, and balancing of equipment and other tests and standards. Testing is required for, but not limited to, the following items of work:
1. Soils-compaction control and hydrocarbon concentrations
2. Cast-in-place concrete
3. Concrete reinforcement
4. Asphalt pavement
5. Cement-Sand Backfill material
6. Crushed limestone base materials
7. Water and sludge
8. Other items in the Scope of Work

1.7 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with laboratory personnel; provide access to the work area.

B. Provide to laboratory, preliminary representative samples of materials to be tested in required quantities.

C. Furnish labor and equipment:
1. To provide access to the work to be tested.
2. To obtain and handle samples at the site.
3. To facilitate inspections and tests.
4. For laboratory's exclusive use for storage and curing of test samples.

1.8 MANUFACTURERS' FIELD SERVICES

A. When specified in 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 or Owner. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Refer to Section 01 33 00 - Submittal Procedures, MANUFACTURERS' FIELD REPORTS article.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 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.

3.2 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.

3.3 TEST AND INSPECTION LOG

A. Prepare a record of tests and inspections. Include the following:
   1. Date test or inspection was conducted
   2. Description of the Work tested or inspected
   3. Date test or inspection results were transmitted to Architect
   4. Identification of testing agency or special inspector conducting test or inspection

B. Maintain log at Project site. Post changes and modifications as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.4 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
   1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
   2. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

SECTION 01 40 15

TESTING LABORATORY SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. The testing laboratory shall make all inspections and perform all tests in accordance with the building code, local authorities, state regulations, **TxDOT Test Standards**, and the ASTM specifications and the Contract Documents.

B. Materials and workmanship not meeting the required standards are to be removed and replaced. Replacement and subsequent testing shall be at the expense of the Contractor.

C. Testing, inspection and certifications specified in other sections of these Specifications shall be paid by the Contractor.

D. Inspection by the laboratory shall not relieve the Contractor or Fabricator of his responsibility to furnish materials and workmanship in accordance with the Contract Documents.

1.2 SELECTION AND PAYMENT:

A. The General Contractor shall employ and pay for services of an independent testing laboratory, to perform inspection and testing services specified in this section and noted in other specifications sections. The selected independent testing laboratory shall furnish unit or hourly costs for performing work as described in this section. The Owner reserves the right to determine which tests and the quantity of each herein described or elected.

1.3 REFERENCED STANDARDS:

A. The latest adopted edition of all standards referenced in the Section shall apply, unless noted otherwise. In case of conflict between these Contract Documents and a referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

1.4 QUALITY ASSURANCE:

A. Testing Laboratory shall meet the requirements of ASTM E329 and ASTM E543.

B. Testing Laboratory shall be insured against errors and omissions by a professional liability insurance policy having a limit of liability not less than $500,000.

C. Testing Laboratory shall be under the direction of a Registered Engineer licensed in the State of Texas, having at least five years experience in inspection and testing of construction materials.

D. Laboratory staff monitoring concrete work shall be ACI certified inspectors.

E. Laboratory staff performing structural steel inspection shall be currently certified AWS Certified Welding Inspectors (CWI), in accordance with the provisions of AWS QCI, "Standard and Guide for Qualification and Certification of Welding Inspectors". The inspector may be supported by assistant inspectors who may perform specific inspection functions under the supervision of the inspector. Assistant inspectors shall be currently certified AWS Certified Associate Welding Inspectors (CAWI). The work of the assistant inspectors shall be regularly monitored by the inspector, generally on a daily basis.

F. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.

1.5 LABORATORY RESPONSIBILITIES:

A. Attend pre-construction meetings and progress meetings when requested, to coordinate work with the Contractor and address quality control issues.

B. Test samples of design mixes submitted by Contractor.

C. Provide qualified personnel at site. Cooperate with Architect/Engineer and Contractor in performance of services.

D. Perform specified inspecting, sampling, and testing of Products in accordance with specified standards.

E. Ascertain compliance of materials and mixes with requirements of Contract Documents.

F. Promptly notify Architect/Engineer and Contractor of observed irregularities or non-conformance of Work or Materials.

G. Perform all inspections and tests in accordance with building code requirements for "Special Inspection" whether or not such inspections are specified in the Contract Documents.

1.6 LABORATORY REPORTS:

A. After each inspection and test, promptly submit copies of laboratory reports to Architect, Engineer, Owner and to Contractor.

B. 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 inspection or test
8. Date of test
9. Results of tests
10. Conformance with Contract Documents.

1.7 LIMITS ON TESTING LABORATORY AUTHORITY:

A. Laboratory may not release, revoke, alter, or enlarge the requirements of the Contract Documents.

B. Laboratory may not approve or accept any portion of the Work, except where such approval is specifically called for in these specifications.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop the Work.

1.8 CONTRACTOR RESPONSIBILITIES:

A. See technical sections of these specifications for specific requirements.

B. Advise laboratory sufficiently in advance of construction operations to allow laboratory to complete any required checks or tests and to assign personnel for field inspection and testing as specified.

C. Provide 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 specifications C31.

D. Provide incidental labor and equipment as required to assist laboratory personnel in obtaining and handling samples at the site and in accessing work for inspection.

E. 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 are required, the laboratory shall be selected and paid by the Contractor.

F. Provide current welder certifications for each welder to be employed.

G. Furnish fabrication and erection inspection of all welds in accordance with the AWS D1.1, Chapter 6.

H. Pre-qualification of all welding procedures to be used in executing the work

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 FILLING AND BACKFILLING:

A. The Contractor shall make available to the laboratory, adequate samples of each fill and backfill material from the proposed sources of supply not less than 10 days prior to the start of the work.

B. Laboratory shall analyze samples as required to provide a soil description and to determine compliance with quality requirements. Perform the following tess:

1. Test for liquid limit in accordance with ASTM D423.
2. Test for plastic limit of soils and plasticity index of soils in accordance with ASTM D424.
3. Tests for moisture density relations of soil in accordance with ASTM D698 or D1557, as applicable.

C. Furnish a report for each individual test and state whether sample conforms to specified requirements or reasons for nonconformance.

D. Inspect under slab drainage material and placement for compliance with specified gradation, quality and compaction.

E. Make in-place compaction test for moisture content, moisture-density relationship, and density of fill material after compaction to determine that backfill materials have been compacted to the specified density. Number of tests shall be as follows:
1. One test for each 5,000 square feet of area of each lift placed under floor slab. Stagger test locations in each lift from those in the previous lift. Perform a minimum of three tests for each lift.
2. One test for each 100 linear feet, or portion thereof, of each lift placed against foundation walls, with locations staggered from those in the previous lift.
3. One test of each lift placed below any isolated footing, and every 100 linear feet under continuous footings, with locations taken on a different side from that in the lift below.

3.2 CONCRETE REINFORCING STEEL AND EMBEDDED METAL ASSEMBLIES:

A. Inspect all concrete reinforcing steel prior to placing of concrete for compliance with the Contract Documents and approved shop drawings. All instances of noncompliance shall be immediately brought to the attention of the Contractor for correction. If uncorrected by the Contractor, they shall be listed in the report.

B. Observe and report on the following:
1. Number and size of bars.
2. Bending and lengths of bars.
3. Splicing.
4. Clearance to forms including chair heights.
5. Clearance between bars or spacing.
6. Rust, form oil, and other contaminations.
7. Grade of Steel.
8. Securing, tying and chairing of bars.
9. Excessive congestion of reinforcing steel.
10. Installation of anchor bolts and placement of concrete around anchor bolts.
11. Fabrication and installation of embedded metal assemblies, including visual inspection of all welds.
12. Visually inspect studs and deformed bar anchors on embedded assemblies for compliance with Contract Documents.

C. Provide a qualified, experienced inspector to inspect reinforcing steel. Inspector shall have a minimum of three years experience inspecting reinforcing steel in project of similar size.

3.3 CONCRETE INSPECTION AND TESTING

A. Secure composite samples of concrete at the jobsite in accordance with ASTM C172.

B. Mold and cure three specimens from each sample in accordance with ASTM C31. The test cylinders shall be stored in the field 24 hours and then carefully transported to the laboratory and cured in accordance with ASTM C31.

C. Test specimens in accordance with ASTM C39. Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information.

D. Make one strength test (three cylinders or beams) for each 75 cubic yards or fraction thereof, of each mix design placed in one day.

E. Make one slump test for each set of cylinders following the procedural requirements of ASTM C143 and ASTM C172. Make additional slump tests whenever the consistency of the concrete appears to vary. Do not permit placement of concrete having measured slump outside the limits given on the drawings, except when approved by the Architect. Slump tests corresponding to samples from which strength tests are made shall be reported with the strength test results. Other slump tests need not be reported.

F. Determine total air content of air entrained normal-weight concrete sample for each strength test in accordance with ASTM C231.

G. Determine temperature of concrete sample for each strength test.

H. Monitor the addition of water at the jobsite and the length of time the concrete is allowed to remain in the truck before placement. Report any significant deviation from the approved mix design to the Architect, the Contractor, and the concrete supplier.

I. Observe the placing of all concrete, except non structural slabs-on-grade and site work. Observe and report on placing method, consolidation, cold joints, and length of drop and displacement of reinforcing. Report deficiencies to the Contractor immediately for corrective action. Inspections may be reduced to a periodic basis when all procedures have been deemed satisfactory by the laboratory.

J. The testing laboratory shall certify each delivery ticket indicating class of concrete delivered (or placed), amount of water added and the time at which the cement and aggregate was dispensed into the truck, and the time at which concrete was discharged from the truck.

K. Evaluation and Acceptance:
   1. If the measured slump or air content of air entrained concrete falls outside the specified limits, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be considered to have failed to meet the requirements of the specifications and shall be rejected.
   2. The strength level of the concrete will be considered satisfactory if the averages of all sets of three consecutive strength test results are equal to or exceed the specified strength and no individual test result (average of two cylinders) is below the specified strength by more than 500 psi.

3. Completed concrete work will be accepted when the requirements of "Specifications for Structural Concrete for Building," ACI 301, Chapter 18 have been met.

L. Comply with ACI 311, "Guide For Concrete Inspection" and "ACI Manual of Concrete Inspection" (SP-2).

M. Inspect the application of curing compound and monitor all curing conditions to assure compliance with Specification requirements. Report curing deficiencies to the Contractor immediately and submit a report to the Architect.

3.4 MASONRY:

A. Compressive Test for Mortar
1. Secure composite samples of mortar at the jobsite in accordance with ASTM C780.
2. Mold and cure three cube specimens in accordance with ASTM C109 and C780. Supervise the curing and protection provided by the contractor for test specimens in the field and the transportation from the field to the laboratory. The specimens shall be stored in the field 24 hours and then be moved to the laboratory and cured in accordance with ASTM C780.
3. Test specimens in accordance with ASTM C780. Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information.
4. Make one strength test (three cubes) for each 2,000 square feet of wall area.

3.5 STRUCTURAL STEEL:

A. Inspect all structural steel during fabrication and during the after erection for conformance with Contract Documents and shop drawings, as requested by the Owner.

B. Shop Inspection:
1. Examination of steel for straightness and alignment.
2. Examination of all fabricated pieces for compliance with Contract Documents and shop drawings.
3. Visual examination of all shop welding.
4. Ultrasonic testing of all full penetration welds.
5. Examination of galvanizing.
6. Examination of installation of shop welded shear studs.
7. Examination of shop painting.

C. Field Inspection:
1. Proper erection of all pieces.
2. Proper installation of all bolts, including the checking of calibration of impact wrenches used with high strength bolts.
3. Plumbness of structure and proper bracing.
4. Field Painting.
5. Visual examination of all field welding.
6. Ultrasonic testing of all penetration welds.
7. Installation of field welded shear studs.

D. Qualification of Welders: Fabricator and erector shall provide the testing laboratory with names of welders to be employed in the work, together with certification that welders have passed

qualification tests within the last year using procedures specified in the AWS D1.1. The Owner shall verify all welders' qualifications.

E. Inspection of shop and field welding shall be "verification inspection", in accordance with Section 6 of AWS D1.1 on an "as needed" basis, and as follows:
   1. Visually inspect the welding of all shop fabricated members and note the location of all cover plates, connectors, bearing stiffeners, splices, and fillet welds for proper return around ends and 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.
   4. The 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 the root pass. Where weld has not penetrated completely, the inspector shall order the joint to be chipped down to sound metal, or gouged out and rewelded. Root passes shall be thoroughly inspected for cracks. All cracks shall be gouged out and rewelded to two inches beyond each end of crack.
   5. The inspector shall check that all welds have been marked with the welders' symbol. The inspector shall make the welds requiring repairs and shall make a reinspection. The inspector shall maintain a written record of all welds. Work completed and inspected shall receive an identification mark by the inspector.
   6. The testing laboratory shall advise the Owner and the Architect of any shop and/or field conditions which, in his opinion, may require further tests and examination by means other than those specified. Such further tests and examinations shall be performed as authorized by the Owner and the Architect.
   7. The Owner reserves the right to use ultrasonic or radiographic inspection to verify the adequacy of all welds. Testing procedures and acceptance criteria shall be as specified in AWS D1.1.

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 endure that the plies have been brought into snug contact.
   2. High strength bolting shall be inspected in accordance with Section 9 of the AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts."
   3. For all high strength bolts, unless specifically noted on the Drawings to require only "snug-tight" installation, the inspector shall observe the required jobsite testing and calibration, and shall confirm that the procedure to be used provides the required tension.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.2 TEMPORARY ELECTRICITY

A. Provide and pay for power service required from utility source as needed for construction operation.
   1 Exercise measures to conserve energy.
   2 Provide and install temporary overhead power from Utility Company.
   3 Set temporary meter and switchgear at start of construction.
   4 Specified switchgear shall not be used to construct building until building is in “dry-in" stage.

B. 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.

C. Permanent convenience receptacles may be utilized during construction.

1.3 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain lighting for construction operations. Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

B. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps for specified lighting levels.

D. Maintain lighting and provide routine repairs.

E. Permanent building lighting may be utilized during construction.

1.4 TEMPORARY HEATING

A. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

B. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Owner must authorize use of permanent system for temporary purposes.

C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in product sections.

1.5 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. Prior to operation of permanent equipment for temporary cooling purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Owner must authorize use of permanent system for temporary purposes..

D. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

1.6 TEMPORARY VENTILATION

A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases. Owner must authorize use of permanent system for temporary purposes.

1.7 TELEPHONE SERVICE

A. Provide, maintain, and pay for telephone service to field office at time of project mobilization.

B. Contractor shall provide, maintain, and pay for telephone service for field operations at time of project mobilization.

C. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.

1.8 FACSIMILE SERVICE

A. Provide, maintain and pay for facsimile service and dedicated telephone line to field office at time of project mobilization.

1.9 TEMPORARY WATER SERVICE

A. Provide and pay for suitable quality water service as needed to maintain specified conditions for construction operations. Exercise measure to conserve energy.

B. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

1.10 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Existing facility use is not permitted. Provide facilities at time of project mobilization.

B. Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

1.11 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 10 persons.

C. Locate offices and sheds minimum distance of 30 feet from existing and new structures. Location shall be within the project site’s limit of construction and approved by the Owner. No use of Owner equipment will be permitted.

D. When permanent facilities are enclosed with operable utilities, relocate offices and storage into building, with written agreement of Owner, and remove temporary buildings.

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 Exterior Materials: Weather resistant, finished color acceptable to Owner.
   4 Interior Materials in Offices: Sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.

5 Lighting for Offices: 50 ft C at desk top height, exterior lighting at entrance doors.
6 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.
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 Employee Residential Occupancy: Not allowed on Owner's property.

J. Maintenance And Cleaning:

K. Maintain approach walks free of mud, water, and snow.

L. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

1.12 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 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 feet 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 existing on-site roads for construction traffic.

1.13 PARKING

A. Provide temporary surface parking areas to accommodate construction personnel.

B. Locate as approved by Owner.

C. When site space is not adequate, provide additional off-site parking.

D. Use of existing on-site streets and driveways used for construction traffic is not permitted.

E. Do not allow heavy vehicles or construction equipment in parking areas.

F. Do not allow vehicle parking on existing pavement.

G. 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.

H. Maintenance:
   1 Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
   2 Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

I. Removal, Repair:
   1 Remove temporary materials and construction when permanent paving is usable.
   2 Remove underground work and compacted materials to depth of 2 feet; fill and grade site as specified.
   3 Repair permanent facilities damaged by use, to original or specified condition.

J. Mud From Site Vehicles: Provide means of removing mud from vehicle wheels before entering streets.

1.14 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. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle wasre from the construction operations. Comply with requirement s of authorities having jurisdiction.

Collect and remove waste materials, debris, and rubbish from site periodically and dispose off-site immediately after filled. Remove waste upon owner's request.

1.15 PROJECT IDENTIFICATION

A. Project Identification Sign:
   1 One painted sign, 32 sq ft area, bottom 6 feet above ground.
   2 Content:
   a. Project number, title, logo and name of Owner as indicated on Contract Documents.
   b. Name of Prime Contractor.
   3 Graphic Design, Colors, Style of Lettering: Reviewed and approved by Owner.
   4 No other signs are allowed without Owner permission except those required by law.

B. Design sign and structure to withstand wind velocity per building code.

C. Sign Painter: Experienced as professional sign painter.

D. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

E. Show content, layout, lettering and color.

F. Sign Materials:
   1 Structure and Framing: New wood , structurally adequate.
   2 Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 3/4 inches thick standard large sizes to minimize joints.
   3 Rough Hardware: Galvanized
   4 Paint and Primers: Exterior quality.

G. Installation:
   1 Erect at designated location.
   2 Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
   3 Install sign surface plumb and level, with butt joints. Anchor securely.
   4 Paint exposed surfaces of sign, supports, and framing.

H. Maintenance: Maintain signs and supports clean, repair deterioration and damage.

I. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area.

1.16 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 Flag person 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.

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 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.

1.17 FIRE PREVENTION

A. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
   1 Prohibit smoking with buildings under construction. Designate area on site where smoking is permitted. Provide approved ashtrays in designated smoking areas.
   2 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.

B. 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.

1.18 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations .

B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.19 ENCLOSURES AND FENCING

A. Construction: Commercial grade chain link fence.

B. Provide 6 feet high fence around construction site; equip with vehicular and pedestrian gates with locks. Contractor may tie into existing chain link fence if it exists to complete enclosure of the construction site.

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.

1.20 SECURITY

A. Security Program:
   1 Protect Work and Owner's operations from theft, vandalism, and unauthorized entry.
   2 Initiate program in coordination with Owner's existing security system 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.
   3 Maintain log of workers and visitors, make available to Owner on request.

C. Personnel Identification (Owner occupied sites):
   1 Provide identification badge to each person authorized to enter premises.
   2 Badge To Include: Personal photograph, name and assigned number, expiration date and employer.
   3 Maintain list of accredited persons, submit copy to Owner on request.
   4 Require return of badges at expiration of their employment on the Work.

D. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

E. Restrictions:
   1 Do no work on days indicated in Owner-Contractor Agreement.

1.21 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.

1.22 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.

1.23 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.

1.24 NOISE CONTROL

A. Provide methods, means, and facilities to minimize noise produced by construction operations.

1.25 PEST CONTROL

A. Provide methods, means, and facilities to prevent pests and insects from damaging the Work.

1.26 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.

1.27 RODENT CONTROL

A. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.28 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Final Application for Payment inspection.

B. Remove underground installations. Grade site as indicated on Drawings.

C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
   1 Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
   1 Materials and facilities that constitute temporary facilities are property of Contractor.
   2 Remove temporary paving not intended for or acceptable for integration into permanent paving. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
   3 At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 1 Section "Closeout Requirements."

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
   1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.

1.3 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use form provided by Owner, reference Section 01 63 00 Substitutions and Product Options.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified material or product cannot be provided.

b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
j. Cost information, including a proposal of change, if any, in the Contract Sum.
k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within 7 days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
   a. Form of Acceptance: Change Order.
   b. Use product specified if Architect cannot make a decision on use of a proposed substitution within time allocated.

B. Comparable Product Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
      b. Use product specified if Architect cannot make a decision on use of a comparable product request within time allocated.

C. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

1.4 QUALTIY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:
   1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
   2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
   3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
   4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.

C. Storage
   1. Store products to allow for inspection and measurement of quantity or counting of units.
   2. Store materials in a manner that will not endanger Project structure.
   3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   4. Store cementitious products and materials on elevated platforms.
   5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
   6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   7. Protect stored products from damage and liquids from freezing.
   8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.6 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
   1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
   2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Refer to Division 2 – 14, 21, 22-28, 31-33 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 70 00 – Execution and Closeout Requirements.

PART 2 PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.
   5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
   6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
   7. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved," comply with provisions in Part 2 "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:
   1. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   2. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   3. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
   4. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
   5. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified

product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.

6. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.
7. Visual Matching Specifications: Where Specifications include the phrase “as selected from manufacturer’s colors, patterns, textures” or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
    a. Standard Range: Where specifications include the phrase “standard range of colors, patterns, textures” or similar phrase, Architect will select color pattern, or texture from manufacturer’s product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase “full range of colors, patterns, textures” or similar phrase, Architect will select color, pattern or texture form manufacturer’s product line that include both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Reference Section 01 25 00 – Substitutions and Procedures.

2.3 COMPARABLE PRODUCTS

A. Conditions: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements.
    1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
    2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
    3. Evidence that proposed product provides specified warranty.
    4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
    5. Samples, if requested.

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
   1. Make vertical work plumb and make horizontal work level.
   2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
   3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
   4. Maintain minimum headroom clearance of 80-ft.in spaces without a suspended ceiling.

B. Comply with Manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use equipment or tools that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

1.2 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction forces.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
   1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
   2. Pre-installation Conferences: Include Owner's construction forces at pre-installation conferences covering portions of the Work that are to receive Owner's work. Attend pre-installation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

1.3 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of Manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

1.4 FINAL CLEANING

A. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instruction.

C. Conduct the following cleaning operations before requesting inspection for certification of Final Completion for entire or a portion of the Project:
1. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
2. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
3. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
4. Remove tools, construction equipment, machinery, and surplus material from Project site.
5. Remove snow and ice to provide safe access to building.
6. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
7. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
8. Sweep concrete floors broom clean in unoccupied spaces.
9. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
10. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
11. Remove labels that are not permanent.
12. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
13. Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
14. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

15. Replace parts subject to unusual operating conditions.
16. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
17. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
18. Clean ducts, blowers, and coils if units were operated without filters during construction.
    a. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
    b. Leave Project clean and ready for occupancy.

D. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

1.5 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer and Owner 14 days prior to start-up 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 start-up, 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.

1.6 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 and instructed by qualified 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 start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time at equipment 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.

1.7 TESTING, ADJUSTING AND BALANCING

A. Refer to Mechanical and Electrical Specifications for specific requirements.

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.

1.8 PROTECTING INSTALLED CONSTRUCTION

A. Provide for temperature and relative humidity as per manufacturer’s written instructions.

B. Protect installed Work and provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. 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.

G. Prohibit traffic from landscaped areas.

1.9 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.
7. Manufacturer’s certificates
8. Reviewed Submittals

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Label and file Record Documents in accordance with Section number listings in Table of Contents of this Project Specifications Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

E. Record information concurrent with construction progress, not less than weekly.

F. 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.

G. Record Drawings and Shop Drawings: Provide felt tip pens, maintaining separate colors for each major system, for recording information. Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first 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.
6. Changes made by Addenda and modifications.
7. References to related shop drawings and modifications.

H. Submit two copies of documents to Architect/Engineer prior to or on Substantial Completion inspection.
1. Transmit with cover letter listing:
   a. Date
   b. Project title and number
   c. Contractor’s name, address, and telephone number.
   d. Number and title of each Record Document.
   e. Signature of Contractor or authorized representative.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 x 11 inch (A4) text pages, three D side ring binders with durable 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.
         1) For equipment having a make, model and serial number, it shall be recorded in the O&M manuals.
      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.

F. Submit two copies of documents to Architect/Engineer prior to or on Substantial Completion inspection.
   1. Transmit with cover letter listing:
      a. Date
      b. Project title and number
      c. Contractor’s name, address, and telephone number.
      d. Number and title of each Record Document.
      e. Signature of Contractor or authorized representative.

1.11 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 substantial completion. Draft copy will be reviewed and returned with Architect/Engineer comments. Revise content of document sets as required prior to substantial completion.

D. Submit two sets of revised final volumes in final form before or on date of substantial completion

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.

1.12 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit a preliminary digital draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review and return a digital 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 a digital copy of completed volumes 15 days prior to substantial completion Draft copy will be reviewed and returned with Architect/Engineer comments. Revise content of document sets as required prior to substantial completion.

D. Submit one (1) digital and one (1) hardcopy set of revised final volumes in final form prior to or on date of substantial completion 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; typed.

G. Include color coded wiring diagrams as installed.

H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.

I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; 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.

1.13 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 or on substantial completion inspection.

1.14 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. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual. Include Table of Contents and assemble in three D side ring binder with durable plastic cover.
   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

F. Submit prior to or on substantial completion inspection.

G. For equipment or components parts of equipment put into service during construction or For items of Work for which acceptance is delayed beyond Date of Substantial Completion refer to the Building General Conditions.

1.15 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   9. Submit test/adjust/balance records.
   10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   11. Advise Owner of changeover in heat and other utilities.
   12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   13. Complete final cleaning requirements, including touchup painting.

14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
15. Complete work on items listed on Punch Lists.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
   1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
   2. Results of completed inspection will form the basis of requirements for Final Completion.

1.16 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
   1. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
   2. Submit evidence of final, continuing insurance coverage complying with insurance requirements.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
   1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.17 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use CSI Form 14.1A or form acceptable to the Owner and Architect..
   1. Organize list of spaces in sequential order, starting with exterior areas first.
   2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
   3. Include the following information at the top of each page:
      a. Project name.
      b. Date.
      c. Name of Architect.
      d. Name of Contractor.
      e. Page number.

1.18 COMPLETED FINAL PUNCHLIST INSPECTION

A. Correct or complete all items on the punchlist before requesting final payment. Unless otherwise agreed upon, the contractor has seven (7) days of receipt of final punchlist. When the final punchlist is complete and the Contract is fully satisfied according to Contract Documents, a certificate establishing the date of Final Completion will be issued.

B. Refer to the Building General Conditions for Owner's right to complete the work in the event the contractor does not complete the final punchlist.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 024116 - STRUCTURE DEMOLITION

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. Demolition and removal of buildings and site improvements.
2. Abandoning in-place and Removing below-grade construction.
3. Disconnecting, capping or sealing, and abandoning in-place and removing site utilities.
4. Removal of existing hazardous Material
5. Salvaging items for reuse by Owner.

B. Related Requirements:

1. Section 003126 “Existing Hazardous Material Information”
2. Section 011000 "Summary" for use of the premises and phasing requirements.
3. Section 013200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged.

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be demolished.
2. Review structural load limitations of existing structures.
3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review and finalize protection requirements.
5. Review procedures for noise control and dust control.
6. Review procedures for protection of adjacent buildings.
7. Review items to be salvaged and returned to Owner.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For refrigerant recovery technician.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

C. Schedule of Building Demolition Activities: Indicate the following:

1. Detailed sequence of demolition work, with starting and ending dates for each activity.
2. Temporary interruption of utility services.
3. Shutoff and capping of utility services.

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before the Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.

1.9 FIELD CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.

1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.
2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.

a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before building demolition, Owner will remove the following items:

a. TxDOT will remove all fixture, furnishings and equipment (FF&E) located in the buildings.

D. Hazardous Materials: Present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.
2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
3. Owner will provide material safety data sheets for materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.

E. On-site storage or sale of removed items or materials is not permitted.

1.10 COORDINATION

A. Arrange demolition schedule so as not to interfere with Owner's on-site operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

2.2 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Remove all hazardous material per report located in 003126

B. Verify that utilities have been disconnected and capped before starting demolition operations.

C. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

D. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during building demolition operations.

E. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

F. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

G. Inventory and record the condition of items to be removed and salvaged.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

B. Salvaged Items: Comply with the following:

1. Clean salvaged items of dirt and demolition debris.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to storage area designated by Owner.
5. Protect items from damage during transport and storage.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Utilities to be Disconnected: Locate, identify, disconnect, and seal or cap off utilities serving buildings and structures to be demolished.

1. Owner will arrange to shut off utilities when requested by Contractor.
2. Arrange to shut off utilities with utility companies.
3. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
4. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.
5. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.4 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities to Remain: Maintain utility services to remain and protect from damage during demolition operations.

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.

    a. Provide at least **72** hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and to and from occupied portions of adjacent buildings and structures.
6. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.5 DEMOLITION, GENERAL

A. General: Demolish indicated buildings and site improvements completely. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
2. Maintain adequate ventilation when using cutting torches.
3. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

C. Explosives: Use of explosives is not permitted.

3.6 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Salvage: Items to be removed and salvaged are indicated on Drawings.

D. Below-Grade Construction: Demolish foundation walls and other below-grade construction.

1. Remove below-grade construction, including basements, foundation walls, and footings, completely.

E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet outside footprint indicated for new construction. Abandon utilities outside this area.

1. Fill abandoned utility structures with satisfactory soil materials according to backfill requirements in Section 312000 "Earth Moving."

F. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.

G. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder, plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.

3.7 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

3.8 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.9 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.10 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.

1. Clean roadways of debris caused by debris transport.

END OF SECTION 024116

SECTION 032000 - CONCRETE REINFORCING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Mechanical splice couplers.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Engineer.

1.3 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

2. Mechanical splice couplers.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.

B. Mechanical Splice Couplers: ACI 318 Type 1, same material of reinforcing bar being spliced; dowel-bar type.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. 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 reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.
3. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

    a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the Engineer.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

END OF SECTION 032000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, and other pozzolans materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each of the following.

1. Portland cement.
2. Fly ash.
3. Slag cement.
4. Blended hydraulic cement.
5. Aggregates.
6. Admixtures:

    a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.

7. Vapor retarders.
8. Curing materials.
   Joint fillers.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Durability exposure class.
4. Maximum w/cm.
5. Air content.
6. Nominal maximum aggregate size.
7. Intended placement method.
8. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

    a. Location of construction joints is subject to approval of the Engineer.

D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:

1. Concrete Class designation.
2. Location within Project.
3. Exposure Class designation.
4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Curing compounds.
4. Vapor retarders.
5. Joint-filler strips.

1.5 QUALITY ASSURANCE

A. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I, or Type II
2. Fly Ash: ASTM C618, Class C or F.
3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.

B. Normal-Weight Aggregates: ASTM C33/C33M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do 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 C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

E. Water and Water Used to Make Ice: ASTM C94/C94M, potable

2.3 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A, not less than 15 milsthick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

C. Water: Potable or complying with ASTM C1602/C1602M.

2.5 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, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Total of Fly Ash or Other Pozzolans, Slag Cement: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass.
4. Total of Fly Ash or Other Pozzolans: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

1. Use 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, and concrete with a w/cm below 0.50.

2.6 CONCRETE MIXTURES

A. Class A : Normal-weight concrete used for interior slabs on grade, footings.
1. Minimum Compressive Strength: As indicated on drawings.
2. Maximum w/cm: 0.45.
3. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

B. Class B: Normal-weight concrete used for stem walls/grade beams
1. Minimum Compressive Strength: As indicated on drawings.
2. Maximum w/cm: 0.45.
3. Air Content: 4.5 percent, plus or minus 1.5 percent at point of delivery

4. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94

PART 3 - EXECUTION

3.1 INSTALLATION OF 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.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.

3.2 INSTALLATION OF VAPOR RETARDER

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides, and sealing to vapor retarder.

3.3 JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Engineer.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.
    b. Do not continue reinforcement through sides of strip placements of floors and slabs.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.4 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Engineer in writing, but not to exceed the amount indicated on the concrete delivery ticket.

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 is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.

3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. 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. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.5 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.

    a. Patch voids larger than 1-1/2 inches wide or 1/2 inch deep.
    b. Remove projections larger than 1 inch.
    c. Tie holes do not require patching.
    d. Surface Tolerance: ACI 117 Class D.
    e. Apply to concrete surfaces not exposed to public view.

2. ACI 301Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117 Class B.

e. Locations: Apply to concrete surfaces exposed to public view.

3.6 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface.
5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view.

3.7 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling In:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 6 incheshigh unless otherwise indicated on Drawings, and extend base not less than 6 inchesin each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 3000 psiat 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.

c. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.8 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301and ACI 306.1 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305.1, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. If forms remain during curing period, moist cure after loosening forms.
3. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:

a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
b. Continuous Sprinkling: Maintain concrete surface continuously wet.
c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.

C. Curing Unformed Surfaces: Comply with ACI 308.1as follows:

1. Begin curing immediately after finishing concrete.
2. Interior Concrete Floors:

a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12-inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

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.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

b. Floors to Receive Polished Finish: Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

3.9 TOLERANCES

A. Conform to ACI 117.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.

3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports shall include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results.
        13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
        14) Type of fracture and compressive break strengths at seven days and 28 days.

B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.

C. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M shall be performed in accordance with 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.

    a. When frequency of testing provides 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.

2. Slump: ASTM C143/C143M:

a. 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.
b. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

4. Concrete Temperature: ASTM C1064/C1064M:

    a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and field cure two sets of three 4-inch by 8-inch cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two field-cured specimens at seven days and one set of three 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.

7. 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 if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Engineer but will not be used as sole basis for approval or rejection of concrete.
9. Additional Tests:

    a. 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.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.

        1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

11. 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 in accordance with ASTM E1155 within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.11 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. 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.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polished concrete finishing and scoring.
2. Concrete for polished concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 033000 "Cast-in-Place Concrete."

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete not designated as polished concrete.

1.2 DEFINITIONS

A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.3 PREINSTALLATION MEETINGS

A. 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 polished 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. Cast-in-place concrete subcontractor.
e. Polished concrete finishing Subcontractor.

2. Review cold- and hot-weather concreting procedures, curing procedures, construction joints, concrete repair procedures, concrete finishing, and protection of polished concrete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

C. Samples for Verification: For each type of exposed color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Repair materials.
2. Stain materials.
3. Liquid floor treatments.

1.6 QUALITY ASSURANCE

A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately 48 by 48 inches minimum, to demonstrate the expected range of finish, color, and appearance variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.
2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
3. Demolish and remove field sample panels when directed.

B. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Demonstrate curing, finishing, and protecting of polished concrete.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

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. ARDEX Americas.
b. Euclid Chemical Company (The); an RPM company.
c. Laticrete International, Inc.
d. MAPEI Corporation.

PART 3 - EXECUTION

3.1 POLISHING

A. Polish: Level 2: Low sheen, 400 grit.

B. 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 and to depth required to reveal aggregate to match approved mockup.
2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
3. 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.
4. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
5. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
6. Control and dispose of waste products produced by grinding and polishing operations.
7. Neutralize and clean polished floor surfaces.

END OF SECTION 033543

SECTION 042000 - UNIT MASONRY

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. Pre-faced concrete masonry units.
2. Building (common) brick.
3. Mortar and grout.
4. Steel reinforcing bars.
5. Masonry-joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.

B. Products Installed but not Furnished under This Section:

1. Cast-stone trim in unit masonry.
2. Steel lintels in unit masonry.
3. Steel shelf angles for supporting unit masonry.
4. Cavity wall insulation.

C. Related Requirements:
1. Section 042000 “Concrete Unit Masonry” for load bearing structural masonry.
2. Section 051200 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
3. Section 071900 "Water Repellents" for water repellents applied to unit masonry assemblies.
4. Section 072100 "Thermal Insulation" for cavity wall insulation.
5. Section 076200 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
6. Section 321400 "Unit Paving" for exterior unit masonry paving.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
3. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Verification: For each type and color of the following:
1. Pre-faced CMUs.
2. Clay face brick.
3. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
4. Weep holes and cavity vents.
5. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

B. Qualification Data: For testing agency.

C. Material Certificates: For each type and size of the following:

1. Masonry units.

a. Include data on material properties material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C67.
d. For surface-coated brick, include test report for durability of surface appearance after 50 cycles of freezing and thawing according to ASTM C67.

e. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include name of manufacturer, brand name, and type.
3. Mortar admixtures.
4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
5. Grout mixes. Include description of type and proportions of ingredients.
6. Reinforcing bars.
7. Joint reinforcement.
8. Anchors, ties, and metal accessories.

D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

E. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C1093 for testing indicated.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups for each type of exposed unit masonry construction typical, exterior wall in sizes approximately 72 inches long by 72 inches high by full thickness, including face and backup wythes and accessories.

a. Include a sealant-filled joint at least 16 inches long in exterior wall mockup.
b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
d. Include metal studs, sheathing joint-and-penetration treatment air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.
e. Include pre-faced CMUs clay face brick on one face of interior unit masonry wall mockup.

3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.

4. Clean exposed faces of mockups with masonry cleaner as indicated.
5. Protect accepted mockups from the elements with weather-resistant membrane.
6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
7. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.

4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
1. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C1314.

2.3 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Pre-faced CMUs: Lightweight hollow concrete units complying with ASTM C90, with manufacturer's standard smooth resinous facing complying with ASTM C744.
1. Size: Manufactured to dimensions specified in "CMUs" Paragraph but with pre-faced surfaces having 1/16-inch-wide returns of facing to create 1/4-inch-wide mortar joints with modular coursing.
2. Colors and Patterns: Match Architect's samples.

2.4 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Building (Common) Brick: ASTM C62, Grade NW, MW, or SW.
1. Size: Match size of face brick.
2. Size (Actual Dimensions): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long.

2.5 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Mortar Cement: ASTM C1329/C1329M.

F. Aggregate for Mortar: ASTM C144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C404.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

2.6 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.
1. Exterior Walls: Hot-dip galvanized carbon steel.
2. Wire Size for Side Rods: 0.148-inch diameter.
3. Wire Size for Cross Rods: 0.148-inch diameter.
4. Wire Size for Veneer Ties: 0.148-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

D. Masonry-Joint Reinforcement for Single-Wythe Masonry: Ladder[**or truss**] type with single pair of side rods.

E. Masonry-Joint Reinforcement for Multiwythe Masonry:
1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.7 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.

B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A641/A641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
3. Stainless Steel Wire: ASTM A580/A580M, Type 304.

4. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
5. Where wythes are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
6. Wire: Fabricate from 3/16-inch-diameter, hot-dip galvanized steel wire.

C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.

D. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from [**steel, hot-dip galvanized after fabrication**] [**stainless steel**].

E. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
2. Fabricate wire ties from 0.187-inch-diameter, hot-dip galvanized-steel wire unless otherwise indicated.
3. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.
4. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours according to ASTM B117.
5. Stainless Steel Drill Screws for Steel Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

2.8 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.

3. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.

4. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
5. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
   a. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch thick.
   b. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch-thick coating of adhesive.
   c. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch thick, with a 0.015-inch-thick coating of rubberized-asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches from edge.

      1) Color: Gray.

   d. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

2. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D4637/D4637M, 0.040 inch thick.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge or flexible flashing with a metal sealant stop.
4. Where flashing is fully concealed, use metal flashing or flexible flashing.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. Termination Bars for Flexible Flashing: Stainless steel bars 0.075 inch by 1 inch.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D2000, Designation M2AA-805 or PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

   2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
   1. Configuration: Provide one of the following:

      a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

   1. Do not use calcium chloride in mortar or grout.
   2. Use portland cement-lime masonry cement or mortar cement mortar unless otherwise indicated.
   3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

   1. For masonry below grade or in contact with earth, use Type M.
   2. For reinforced masonry, use Type S.

3. For mortar parge coats, use Type S or Type N.
4. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
5. For interior nonload-bearing partitions, Type O may be used instead of Type N.

C. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.

1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of masonry cement or mortar cement by weight.
3. Mix to match Architect's sample.
4. Application: Use pigmented mortar for exposed mortar joints with the following units:

    a. Decorative CMUs.
    b. Pre-faced CMUs.
    c. Hollow brick.
    d. Stone trim units.
    e. Cast-stone trim units.

D. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.

1. Mix to match Architect's sample.
2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:

    a. Decorative CMUs.
    b. Pre-faced CMUs.
    c. Hollow brick.
    d. Stone trim units.
    e. Cast-stone trim units.

E. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

F. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.

1. Application: Use epoxy pointing mortar for exposed mortar joints with the following units:

a. Pre-faced CMUs.
b. Glazed brick.
c. Glazed structural clay facing tile.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that impair mortar bond.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in stack bond and bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
5. Fully bed units and fill cells with mortar at anchors and ties as needed to fully embed anchors and ties in mortar.

B. Lay solid masonry units and hollow brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

E. Cut joints flush where indicated to receive cavity wall insulation and air barriers unless otherwise indicated.

3.6 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 4.5 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

    a. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) ties.
    b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.

2. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not more than 8 inches clear horizontally and 16 inches clear vertically.
3. Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Parge cavity face of backup wythe in a single coat approximately 3/8 inch thick. Trowel face of parge coat smooth.

E. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.7 ANCHORED MASONRY VENEERS

A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.

2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
3. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than one anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

B. Provide airspace shown on drawings between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

3.8 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:

1. Provide an open space not less than space indicated on drawings between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, AND CAVITY VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape.
2. At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches. Fasten upper edge of flexible flashing to sheathing through termination bar.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

5. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

1. Use specified weep/cavity vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches o.c. unless otherwise indicated.
4. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.
5. Trim wicking material flush with outside face of wall after mortar has set.

E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.

I. Prism Test: For each type of construction provided, according to ASTM C1314 at 7 days and at 28 days.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
6. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.15 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

C. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

D. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042000

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Steel reinforcing bars.

1.2 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For reinforcing steel. Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product. For masonry units, include data on material properties, and material test reports substantiating compliance with requirements.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
2. Include test reports, according to ASTM C1019, for grout mixes required to comply with compressive strength requirement.

1.5 FIELD CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost

or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. CMUs: ASTM C90.

2.3 CONCRETE LINTELS

A. Concrete Lintels: ASTM C1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C91/C91M.

E. Aggregate for Mortar: ASTM C144.

F. Aggregate for Grout: ASTM C404.

G. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated-Steel Reinforcing Bars: ASTM A615/A615M , Grade 60.

B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

C. Masonry-Joint Reinforcement, General: ASTM A951/A951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.187-inch diameter.
4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units].

2.6 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate metal expansion-joint strips from [**stainless steel**] [**copper**] to shapes indicated.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from PVC.

B. Preformed Control-Joint Gaskets: Made from PVC, complying with ASTM D2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.

B. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type S.

C. Grout for Unit Masonry: Comply with ASTM C476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C143/C143M.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.

E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. Bed face shells in mortar and make head joints of depth equal to bed joints.
2. Bed webs in mortar in all courses of piers, columns, and pilasters.
3. Bed webs in mortar in grouted masonry, including starting course on footings.
4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.

B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY-JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 REINFORCED UNIT MASONRY

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and that of other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.7 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level B in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 10,000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.

3.8 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.9 MASONRY WASTE DISPOSAL

A. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 051200 – STRUCTURAL STEEL FRAMING

GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel.
2. Shrinkage-resistant grout.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Anchor rods.
4. Threaded rods.
5. Forged-steel structural hardware.
6. Shop primer.
7. Galvanized-steel primer.
8. Galvanized repair paint.
9. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

C. Calculations: Complete Engineering Analysis for all structural steel connections signed and sealed by a Professional Engineer registered in Texas. Shop drawings will not be reviewed if not accompanied by associated connection calculations.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural-steel materials, including chemical and physical properties.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 360.
3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Fabricator's experienced steel detailer shall select or complete connections in accordance with ANSI/AISC 303.

a. Select and complete connections using schematic details indicated and ANSI/AISC 360.
b. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Moment Connections: Type FR, fully restrained.

D. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M Grade 50.

B. Channels, Angles: ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade C.

E. Steel Pipe: ASTM A53/A53M, Grade B.

F. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.

1. Configuration: Straight.
2. Finish: Plain

B. Threaded Rods: ASTM A36/A36M

1. Finish: Plain

2.5 FORGED-STEEL STRUCTURAL HARDWARE

A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.

2.6 PRIMER

A. Steel Primer:

1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.7 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

2.9 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates and Bearing 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 shrinkage-resistant 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 grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

3.3 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

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 ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1) Liquid Penetrant Inspection: ASTM E165/E165M.
2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3) Ultrasonic Inspection: ASTM E164.
4) Radiographic Inspection: ASTM E94/E94M.

END OF SECTION 051200

SECTION 052100 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. K-series steel joists.
2. Steel joist accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings and Calculations:

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. Include a comprehensive Engineering Analysis justifying the steel joist design. Calculations shall be signed and sealed by a Professional Engineer registered in Texas.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Manufacturer certificates.

C. Mill Certificates: For each type of bolt.

D. Field quality-control reports.

1.4 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."

PART 2 - PRODUCTS

2.1 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification 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. 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.

2.2 PRIMERS

A. Primer:

1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.3 STEEL JOIST ACCESSORIES

A. Bridging:

1. Provide bridging anchors and number of rows of horizontal and/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. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction.

1. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated on Drawings.

C. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.4 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.

B. Apply one coat of shop primer to joists and joist accessories.

PART 3 - EXECUTION

3.1 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 SJI's "Specifications," joist manufacturer's written instructions, 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.

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. 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.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION 052100

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.
2. Noncomposite form deck.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Noncomposite form deck.

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.

1.3 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Welding certificates.
2. Product Certificates: For each type of steel deck.

B. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that power-actuated mechanical fasteners comply with requirements.
2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

D. Qualification Statements: For welding personnel.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding code:

a. AWS D1.3/D1.3M.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33 G90 zinc coating.
2. Deck Profile: As indicated
3. Profile Depth: As indicated
4. Design Uncoated-Steel Thickness: As indicated
5. Span Condition: As indicated
6. Side Laps: Overlapped

2.2 NONCOMPOSITE FORM DECK

A. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite deck panels used as a form to comply with SDI NC, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), **Grade 33 G90** zinc coating.
2. Deck Profile: As indicated
3. Profile Depth: As indicated
4. Design Uncoated-Steel Thickness: As indicated
5. Span Condition: As indicated
6. Side Laps: Overlapped

2.3 ACCESSORIES

A. 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 recommended by SDI standards for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. 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.

I. Galvanizing Repair Paint: ASTM A780/A780M

J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; 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.

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.

3.2 INSTALLATION OF ROOF DECK

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: 5/8 inch, nominal.
2. Weld Spacing: As indicated.

B. Side-Lap and Perimeter Edge Fastening: As indicated.

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 mechanically 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 in accordance with deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.3 INSTALLATION OF FLOOR DECK

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: **5/8 inch** nominal.
2. Weld Spacing:

a. Weld edge ribs of panels at each support. Space additional welds an average of 16 inches apart, but not more than 18 inches apart.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

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

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.4 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Exterior non-load-bearing wall framing.
2. Soffit framing.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cold-formed steel framing materials.
2. Exterior non-load-bearing wall framing.
3. Vertical deflection clips.
4. Single deflection track.
5. Double deflection track.
6. Soffit framing.
7. Post-installed anchors.
8. Power-actuated anchors.
9. Sill sealer gasket.
10. Sill sealer gasket/termite barrier.

B. Shop Drawings:

1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing, including calculations for all loads, members and connections signed and sealed by an Professional Engineer registered in Texas.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Research Reports:

1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
2. For sill sealer gasket/termite barrier, showing compliance with ICC-ES AC380.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association or.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

E. Comply with AISI S230 "Standard for Cold-Formed Steel Framing - Prescriptive Method for One and Two Family Dwellings."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.

3. Design framing systems to provide for movement of framing members located outside the insulated building envelope 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 of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

    a. Upward and downward movement of 1 1/2 inches minimum.

5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

D. Fire-Resistance Ratings: Comply with ASTM E119; 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 acceptable to authorities having jurisdiction.

2.2 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: As required by structural performance.

2. Coating: G60, A60, AZ50, or GF30.

B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: As required by structural performance.
2. Coating: G60.

2.3 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0677 inch.
2. Flange Width: 1-5/8 inches minimum.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.
2. Flange Width: 1-1/4 inches.

C. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: 0.0677 inch.
2. Flange Width: 1 inch plus the design gap for one-story structures.

2.4 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches, minimum.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole-reinforcing plates.
11. Backer plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled expansion anchor, Torque-controlled adhesive anchor or adhesive anchor.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

E. Sill Sealer Gasket: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

F. Sill Sealer Gasket/Termite Barrier: Minimum 68-mil nominal thickness, self-adhering sheet consisting of 64 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film reinforcement, and with release liner on adhesive side.
   1. Physical Properties:
      a. Peel Adhesion: 17.0 lb/in of width when tested in accordance with ASTM D412.
      b. Low-Temperature Flexibility: Pass at minus 25 deg FASTM D146/D146M.
      c. Water Vapor Permeance: 0.05 perm maximum when tested in accordance with ASTM E96/E96M, Method B.
      d. Resistance to Termite Penetration: Comply with ICC-ES AC380.

2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.
   4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation 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 cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Install sill sealer gasket at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install double deep-leg deflection tracks and anchor outer track to building structure.
2. Connect vertical deflection clips to infill studs and anchor to building structure.
3. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. 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.

3.6 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel framing and supports for ceiling-anchored toilet compartments.
2. Steel framing and supports for overhead doors.
3. Steel framing and supports for countertops.
4. Steel tube reinforcement for low partitions.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Slotted channel framing.
8. Shelf angles.
9. Metal floor plate and supports.
10. Structural-steel door frames.
11. Miscellaneous steel trim including steel angle corner guards steel edgings.
12. Metal bollards.
13. Pipe and Downspout guards.
14. Cast-iron wheel guards.
15. Metal downspout boots.
16. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

C. Related Requirements:

1. Section 042000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
2. Section 051200 "Structural Steel Framing" for steel framing, supports, door frames, and other steel items attached to the structural-steel framing.
3. Section 077200 "Roof Accessories" for manufactured metal roof walkways and metal roof stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Fasteners.
3. Shop primers.
4. Shrinkage-resisting grout.
5. Prefabricated building columns.
6. Slotted channel framing.
7. Manufactured metal ladders.
8. Metal bollards.
9. Pipe and Downspout guards.
10. Metal downspout boots.

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for ceiling-anchored toilet compartments.
2. Steel framing and supports for overhead doors.
3. Steel framing and supports for countertops.
4. Steel tube reinforcement for low partitions.
5. Steel framing and supports for mechanical and electrical equipment.
6. Shelf angles.
7. Metal ladders.
8. Miscellaneous steel trim including steel angle corner guards steel edgings.
9. Metal bollards.
10. Loose steel lintels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Research Reports: For post-installed anchors.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, floor slabs, decks, and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

C. Rolled-Steel Floor Plate: ASTM A786/A786M, rolled from plate complying with ASTM A36/A36M or ASTM A283/A283M, Grade C or D.

D. Rolled-Stainless Steel Floor Plate: ASTM A793.

E. Steel Tubing: ASTM A500/A500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A53/A53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. Zinc-Coated Steel Wire Rope: ASTM A741.

1. Wire Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

H. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

I. Aluminum Plate and Sheet: ASTM B209, Alloy 6061-T6.

J. Aluminum Extrusions: ASTM B221, Alloy 6063-T6.

K. Aluminum-Alloy Rolled Tread Plate: ASTM B632/B632M, Alloy 6061-T6.

L. Aluminum Castings: ASTM B26/B26M, Alloy 443.0-F.

M. Nickel Silver Extrusions: ASTM B151/B151M, Alloy UNS No. C74500.

N. Nickel Silver Castings: ASTM B584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless steel fasteners for fastening aluminum, stainless steel or nickel silver.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.

D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

H. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for glass partitions from continuous steel beams of sizes indicated] with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime exterior miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.9 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe.

1. Fill bollards with concrete then dome top.
2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

B. Fabricate bollards with 3/8-inch-thick, steel baseplates for bolting to concrete slab. Drill baseplates at all four corners for 3/4-inch anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

C. Prime steel bollards with zinc-rich primer.

2.10 METAL DOWNSPOUT BOOTS

A. Source Limitations: Obtain downspout boots from single source from single manufacturer.

B. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.

1. Outlet: Vertical, to discharge into pipe.

C. Prime cast-iron downspout boots with zinc-rich primer.

2.11 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize bearing and leveling plates.

C. Prime plates with zinc-rich primer.

2.12 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.13 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.14 GENERAL FINISH REQUIREMENTS

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with primers specified in Section 099113 "Exterior Painting" primers or specified in Section 099123 "Interior Painting" unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for ceiling hung toilet partitions, glass partitions securely to, and rigidly brace from, building structure.

C. Anchor shelf angles securely to existing construction with expansion anchors.

D. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

E. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installation of Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLATION OF METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

1. Do not fill removable bollards with concrete.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

1. Do not fill removable bollards with concrete.
2. Provide polyethylene bollard Cover w/ (2) red stripes @ top

3.4 INSTALLATION OF PIPE GUARDS

A. Provide pipe guards at exposed vertical pipes in at locations indicated on Drawings where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.5 INSTALLATION OF BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with shrinkage-resistant grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.6 REPAIRS

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

    a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055000

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Rooftop equipment bases and support curbs.
3. Wood blocking, cants, and nailers.
4. Wood furring.
5. Wood sleepers.
6. Plywood backing panels.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2 inches nominal or greater size but less than 5 inches nominal size in least dimension.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.

1.4 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Post-installed anchors.
5. Metal framing anchors.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:
1. Concealed blocking.
2. Roof framing and blocking.
3. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
4. Plywood backing panels.

2.3 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.
7. Utility shelving.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.

C. Concealed Boards: 15 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Screws for Fastening to Metal Framing: ASTM C1002, length as recommended by screw manufacturer for material being fastened.

D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.6 METAL FRAMING ANCHORS

A. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

B. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.7 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking,and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

D. Do not splice structural members between supports unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

3.2 INSTALLATION OF WOOD BLOCKING AND NAILER

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

D. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Parapet sheathing.
4. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for plywood backing panels.
2. Section 072726 "Fluid applied membrane air barrier" for water-resistive barrier applied over wall sheathing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier and water-resistant glass-mat gypsum sheathing requirements and installation, special details, transitions, mockups, air-leakage testing, protection, and work scheduling that covers air-barrier and water-resistant glass-mat gypsum sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5516.
2. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier and water-resistant glass-mat gypsum sheathing assemblies.

1. Show locations and extent of sheathing, accessories, and assemblies specific to Project conditions.
2. Include details for sheathing joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

3. Include details of interfaces with other materials that form part of air barrier.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer..

B. Product Certificates: From air-barrier and water-resistant glass-mat gypsum sheathing manufacturer, certifying compatibility of sheathing accessory materials with Project materials that connect to or that come in contact with the sheathing.

C. Product Test Reports: For each air-barrier and water-resistant glass-mat gypsum sheathing assembly, indicating compliance with specified requirements, for tests performed by a qualified testing agency.

D. Evaluation Reports: For the following, from ICC-ES:

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Testing Agency Qualifications:
1. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified according to ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
   1. Type and Thickness: Type X, 5/8 inch thick.
   2. Size: 48 by 96 inches for vertical installation.

2.3 ROOF - PARAPET SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
   1. Type and Thickness: Type X, 5/8 inch thick.
   2. Size: 48 by 96 inches for vertical installation.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

   1. For roof, parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
   2. For roof, parapet and wall sheathing, provide fasteners with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

   1. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
   2. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
2. ICC-ES evaluation report for fastener.

D. Coordinate wall, parapet and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.
2. For sheathing under stucco cladding, panels may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.
3. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.3 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 FIELD QUALITY CONTROL

A. Testing and Inspecting Agency: Engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier and water-resistant glass-mat gypsum sheathing, accessories, and installation are subject to inspection for compliance with requirements.

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
3. Termination mastic has been applied on cut edges.
4. Strips and transition strips have been firmly adhered to substrate.
5. Compatible materials have been used.
6. Transitions at changes in direction and structural support at gaps have been provided.
7. Connections between assemblies (sheathing and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
8. All penetrations have been sealed.

C. Tests: As determined by testing agency from among the following tests:

1. Air-Leakage-Location Testing: Air-barrier sheathing assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers.

D. Air barriers will be considered defective if they do not pass tests and inspections.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

F. Prepare test and inspection reports.

END OF SECTION 061600

SECTION 064116 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic-laminate-clad architectural cabinets.
2. Cabinet hardware and accessories.
3. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

C. Samples for Verification: For the following:

1. Plastic Laminates: 8 by 10 inches, for each type, color, pattern, and surface finish required.

a. Provide one sample applied to core material with specified edge material applied to one edge.

2. Thermally Fused Laminate (TFL) Panels: 8 by 10 inches, for each color, pattern, and surface finish.

a. Provide edge banding on one edge.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For the following:

1. Composite wood products.
2. Thermally fused laminate panels.
3. High-pressure decorative laminate.
4. Glass.
5. Adhesives.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

B. Installer Qualifications: Manufacturer of products or Licensed participant in AWI's Quality Certification Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations with Humidity Control: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.

B. Architectural Woodwork Standards Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: Grade HGS.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.

a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch minimum thickness, matching laminate in color, pattern, and finish.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: Thermally fused laminate panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermally fused laminate panels.

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. Match Architect's sample.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
2. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

B. Frameless Concealed Hinges (European Type): ANSI/BHMA A156.9, B01602, 100 degrees of opening.

C. Back-Mounted Pulls: ANSI/BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

E. Catches: Push-in magnetic catches, ANSI/BHMA A156.9, B03131.

F. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04102; with shelf brackets, B04112.

G. Drawer Slides: ANSI/BHMA A156.9.
1. Heavy-Duty (Grade 1HD-100 and Grade 1HD-200): Side mount.

a. Type: Full extension.
b. Material: Zinc-plated ball bearing slides.
c. Motion Feature: Push to open and Soft close dampener .

2. Pencil drawers not more than 3 inches high and not more than 24 inches wide, provide 50 lb load capacity.
3. General-purpose drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide 75 lb load capacity.
4. File drawers more than 6 inches high or more than 24 inches wide, provide 100 lb load capacity.
5. Lateral file drawers more than 6 inches high and more than 24 inches but not more than 30 inches wide, provide 150 lb load capacity.
6. Lateral file drawers more than 6 inches high and more than 30 inches wide, provide 200 lb load capacity.
7. Computer keyboard tray, provide 75 lb load capacity.

H. Door and Drawer Silencers: ANSI/BHMA A156.16, L03011.

I. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Color: Black.

J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with ANSI/BHMA A156.18 for ANSI/BHMA finish number indicated.
1. Satin Stainless Steel: ANSI/BHMA 630.

K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in ANSI/BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.

1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

D. Install glass to comply with applicable requirements in Section 088000 "Glazing" and in GANA's "Glazing Manual."

1. For glass in frames, secure glass with removable stops.
2. For exposed glass edges, polish and grind smooth.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.

1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
2. Install cabinets without distortion so doors and drawers fit openings 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.
3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with toggle bolts through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 064116

SECTION 066400 - PLASTIC PANELING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plastic sheet paneling.
2. Factory-laminated plastic sheet paneling.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring for installing plastic paneling.
2. Section 102600 "Wall and Door Protection" for corner guards installed over plastic paneling.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.3 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.

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. Crane Composites, Inc.
    b. Marlite.
    c. Newcourt, Inc.

2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E84. Identify products with appropriate markings of applicable testing agency.

    a. Flame-Spread Index: 25 or less.
    b. Smoke-Developed Index: 450 or less.

3. Nominal Thickness: Not less than 0.09 inch.
4. Surface Finish: Molded pebble texture.
5. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Match panels.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer.

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches wide.

1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install factory-laminated panels using concealed mounting splines in panel joints.

D. Install trim accessories with nails or staples. Do not fasten through panels.

E. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

F. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

G. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

H. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral wool blanket

B. Related Requirements:

1. Section 042000 "Unit Masonry" for insulation installed in masonry cells.
2. Section 061600 "Sheathing" for foam-plastic board sheathing installed directly over wood or steel framing.
3. Section 075419 "Polyvinyl-Chloride (PVC) Roofing" for insulation specified as part of roofing construction.
4. Section 092900 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Extruded polystyrene foam-plastic board insulation.
2. Glass-fiber blanket insulation.
3. Mineral wool blanket

1.3 INFORMATIONAL SUBMITTALS

A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.

1. For blown-in or sprayed fiberglass and cellulosic-fiber loose-fill insulation, indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
2. Sign, date, and post the certification in a conspicuous location on Project site.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Research Reports: For foam-plastic insulation, from ICC-ES.

1.4 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 until just before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD INSULATION

A. Extruded Polystyrene Board Insulation, Type IV: ASTM C578, Type IV, 25-psi minimum compressive strength; unfaced.

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. Dow Chemical Company (The).
b. Owens Corning.

2. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
3. Smoke-Developed Index: Not more than 450 when tested in accordance with ASTM E84.
4. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
5. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.2 GLASS-FIBER BLANKET INSULATION

A. Glass-Fiber Blanket Insulation, Unfaced: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.
1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.3 MINERAL-WOOL BLANKET INSULATION

A. Mineral-Wool Blanket Insulation, Unfaced: ASTM C665, Type I (blankets without membrane facing); consisting of fibers; passing ASTM E136 for combustion characteristics.
   1. Flame-Spread Index: Not more than 25 when tested in accordance with ASTM E84.
   2. Smoke-Developed Index: Not more than 50 when tested in accordance with ASTM E84.
   3. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

2.4 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position with self-locking washer in place.
   1. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   2. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch in diameter; length to suit depth of insulation.

B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
   1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:
      a. Ceiling plenums.

C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates without damaging insulation, fasteners, or substrates.

2.5 ACCESSORIES

A. Insulation for Miscellaneous Voids:

   1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
   2. Spray Polyurethane Foam Insulation: ASTM C1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84.
   3. Polyurethane Pour-In-Place Insulation: Closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E84, specifically formulated for pour-in-place applications.

B. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Install insulation with manufacturer's R-value label exposed after insulation is installed.

D. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

E. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF CAVITY-WALL INSULATION

A. Foam-Plastic Board Insulation: Install pads of adhesive spaced approximately 24 inches o.c. both ways on inside face and as recommended by manufacturer.

1. Fit courses of insulation between wall ties and other obstructions, with edges butted tightly in both directions, and with faces flush.
2. Press units firmly against inside substrates.
3. Supplement adhesive attachment of insulation by securing boards with two-piece wall ties designed for this purpose and specified in Section 042000 "Unit Masonry."

3.4 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vapor-permeable, fluid-applied air barriers.

B. Related Requirements:

   1. Section 061600 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.2 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessories applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

   1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

   1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.

2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

    a. Coordinate construction of mockups to permit inspection and testing of air barrier before external insulation and cladding are installed.
    b. Include junction with roofing membrane[**, building corner condition,**] [**and**] [**foundation wall intersection**].
    c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on field mockups.

B. Mockup Testing: Air-barrier assemblies shall comply with performance requirements indicated, as evidenced by reports based on mockup testing by a qualified testing agency.
   1. Air-Leakage-Volume Testing: Mockups will be tested for air-leakage rate according to ASTM E783.
   2. Adhesion Testing: Mockups will be tested for required air-barrier adhesion to substrate according to ASTM D4541.
   3. Notify Architect seven days in advance of the dates and times when mockups will be tested.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

   1. Protect substrates from environmental conditions that affect air-barrier performance.
   2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E2357.

2.3 HIGH-BUILD AIR BARRIERS, VAPOR PERMEABLE

A. High-Build, Vapor-Permeable Air Barrier: synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils or thicker over smooth, void-free substrates.

1. Synthetic Polymer Type:

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) GCP Applied Technologies Inc.; Perm-A-Barrier VP.
2) Henry Company; Air-Bloc 31MR.

b. Physical and Performance Properties:
c. Watertightness (CAN/CGSB-37.58-M86): Pass
d. Solids Content:
1) By Weight: 60%
e. Service Temperature:
1) Low Temperature: -40 degrees F (-40 degrees C)
2) High Temperature: 158 degrees F (70 degrees C)
f. Tensile Strength (ASTM D412): 137 psi (950 kPa)
g. Elongation (ASTM D412): 1000%
h. Nail Sealability (ASTM D1970): Pass
i. VOC Content: 15 grams/liter max.
j. Water Vapor Permeance (ASTM E96 B) @ 40 mils nominal dry film: 21 perms
k. Air Permeability:
1) Assembly Air Leakage (ASTM E2357): Pass
2) Building Material (ASTM E2178): 0.0001 cfm/ft2 (0.0002 L/s.m2)
l. Chemical Resistance: Resists salt solutions, mild acids and alkalis. Non-resistant to oils, grease or solvents
m. Fire Testing (NFPA 285): Complies in various assemblies
n. Flame Spread/Smoke Development (ASTM E84): 10/60
o. Resistance to Mold, Mildew, and Fungal Growth (ASTM D5590): No growth

2.4 ACCESSORY MATERIALS

A. Requirement: Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid Primer for self-adhering membranes at temperatures above 25 degrees F shall be Aquatac Primer manufactured by Henry; a polymer emulsion based adhesive, quick setting.

C. Stainless-Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

D. Sealants:
   1. Moisture cure, medium modulus polymer modified sealing compound, having the following typical properties:
      a. Basis of Design Product: Henry® 925 BES Sealant
      b. Complies with Fed. Spec. TT-S-00230C, Type II, Class A.
      c. Complies with ASTM C920, Type S, Grade NS, Class 35.

E. Self-Adhesive Thru-Wall Flashing:
   1. Non-vapor permeable, self-adhered water resistive air and vapor barrier consisting of an SBS rubberized asphalt compound, integrally laminated to a yellow engineered thermoplastic film, having the following typical properties:
      a. Basis of Design Product: Blueskin® TWF
      b. Color: Yellow

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
   3. Verify that substrates are visibly dry and free of moisture.
   4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Surfaces must be sound, dry to touch, clean, and free of oil, grease, dirt, excess mortar, frost, laitance, loose and flaking particles, or other contaminants.

B. Hot weather or direct-sun applications over porous substrates, such as concrete, promote rapid surface drying and can form blisters in the air barrier during curing. To aid in blister prevention prepare substrate in accordance with one of the following optional procedures:
   1. Prime coat:
      a. Apply a thin prime coat of air barrier onto substrate.
      b. Allow air barrier to fully cure prior to subsequent applications.
      c. Install primary air barrier to Air Barrier Manufacturer minimum mil thickness.
   2. Two-coat:
      a. Apply air barrier to achieve one-half (1/2) of Air Barrier Manufacturer minimum mil thickness.
      b. Allow air barrier to fully cure prior to subsequent applications.

c. Apply air barrier to achieve one-half (1/2) of Air Barrier Manufacturer minimum mil thickness.

3.3 ACCESSORIES INSTALLATION

A. Install accessory materials according to air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, transition strip.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.4 PRIMARY AIR-BARRIER MATERIAL INSTALLATION

A. Verify substrate is ready to receive the air barrier assembly in accordance with the Air Barrier Manufacturer's TDS and guide specification.

B. Do not install air barrier when ambient (air) and substrate temperatures are below 40 degrees F (4 degrees C).

C. Do not proceed with application of air barrier when rain is expected within 16 hours.

D. Refer to Air Barrier Manufacturer detail drawings for installation procedures including, but not limited to, the following:
1. Changes in substrate
2. Control joints
3. Crack treatment
4. Expansion joints
5. Inside corners
6. Outside corners
7. Penetrations
8. Rough openings
9. Sheathing Joints

E. Moving Joints:
1. Contact Air Barrier Manufacturer.

F. Contact Air Barrier Manufacturer to coordinate transition of air barrier to adjacent areas including, but not limited to, the following:
1. Roof to air barrier
2. Air barrier to waterproofing
3. Fastener penetrations

G. Thru-Wall Flashing:
1. Coordinate with Section [project specific].

H. Primary Air Barrier
1. Install air barrier assembly in accordance with Air Barrier Manufacturer product specific TDS, details, guide specification, and technical bulletins to create a monolithic air and watertight application without sags, runs or voids.
2. Lap air barrier onto flashing (1) inch (2.5 cm) minimum.
3. Application Rates:
   a. Rates may vary depending upon the porosity of the substrate.

b. Smooth surfaces such as exterior gypsum sheathing or formed concrete:
   1) Wet film thickness: 70 mils (1.75 mm)
c. Rough surfaces such as CMU:
   1) Wet film thickness: 90 mils (2.3 mm)

3.5 FIELD QUALITY CONTROL

A. Final Observation and Verification:
   1. Final inspection of air barrier assembly shall be carried out by the Architect and General Contractor and Air Barrier Manufacturer as required by warranty.

B. Air barrier assembly is not designed for permanent UV exposure. Refer to Air Barrier Manufacturer published literature for product limitations.

3.6 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

   1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials according to air-barrier manufacturer's written instructions.
   2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074113.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standing-seam metal roof panels.

B. Related Sections:

1. Section 074293 "Soffit Panels" for metal panels used in horizontal soffit applications.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of roof accessories and roof-mounted equipment.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review structural loading limitations of deck during and after roofing.
6. Review flashings, special details, drainage, penetrations, equipment curbs, and condition of other construction that affect metal panels.
7. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
8. Review temporary protection requirements for metal panel systems during and after installation.
9. Review procedures for repair of metal panels damaged after installation.
10. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof area and eave, including fascia, and soffit as shown on Drawings; approximately 48 inches square by full thickness, including attachments, underlayment, and accessories.
2. Build mockups for typical roof area only, including accessories.

a. Size: 12 feet long by 6 feet.
b. Each type of exposed seam and seam termination.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.

b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Energy Performance: Provide roof panels that are listed on the EPA/DOE's ENERGY STAR "Roof Product List" for steep-slope roof products.

B. Energy Performance: Provide roof panels according to one of the following when tested according to CRRC-1:

1. Three-year, aged solar reflectance of not less than 0.55 and emissivity of not less than 0.75.
2. Three-year, aged Solar Reflectance Index of not less than 64 when calculated according to ASTM E1980.

C. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

D. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

E. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 15 lbf/sq. ft..

F. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E2140.

G. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.

H. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E1514.

B. Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; **Zee-lock (90º seam)** or comparable product.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.028 inch.
b. Exterior Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

3. Clips: Continuous Zee-rib with Vinyl Weatherseal to accommodate thermal movement.

a. Material: 0.028-inch-nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.

b. Material: 0.0625-inch-thick, stainless steel sheet.

4. Joint Type: Single folded.
5. Panel Coverage: 16 inches.
6. Panel Height: 2.0 inches.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D1970.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645; cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch-nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.

1. Insulate roof curb with 1-inch-thick, rigid insulation.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads.

F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.5 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

3.3 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated on drawings, wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply over the entire roof surface.

B. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 076200 "Sheet Metal Flashing and Trim."

3.4 INSTALLATION OF STANDING SEAM METAL ROOF PANELS

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
4. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
5. Watertight Installation:

    a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
    b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
    c. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed 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 weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

H. Roof Curbs: Install flashing around bases where they meet metal roof panels.

I. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.5 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113.16

SECTION 074293 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal soffit panels.

B. Related Sections:

1. Section 074113.16 " Standing Seam Metal Roof Panels " for lap-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/240 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint

sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METAL SOFFIT PANELS

A. Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Metal Soffit Panels: Match profile and material of metal roof panels.

1. Finish: Match finish and color of metal roof panels.
2. Sealant: Factory applied within interlocking joint.

C. Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and a flat pan between panel edges; with flush joint between panels.
1. Material: Same material, finish, and color as metal roof panels.
2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

a. Nominal Thickness: 0.028 inch.
b. Exterior Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

2.4 FABRICATION

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.

a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 INSTALLATION

A. Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074293

SECTION 075423 - THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Mechanically fastened, thermoplastic polyolefin (TPO) roofing system.
2. Roof insulation.
3. Cover board.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
3. Section 072100 "Thermal Insulation" for insulation beneath the roof deck.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for manufactured copings and roof edge flashings.
6. Section 077129 "Manufactured Roof Expansion Joints" for manufactured roof expansion-joint assemblies.
7. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.2 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to Work of this Section.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

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 methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with adjoining air barrier.

C. Samples for Verification: For the following products:

1. Roof membrane and flashings, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, for tests performed by a qualified testing agency, indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field Test Reports:
   1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, and, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

1. Accelerated Weathering: Roof membrane shall withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roof membrane shall resist impact damage when tested according to ASTM D3746, ASTM D4272, or the "Resistance to Foot Traffic Test" in FM Approvals 4470.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897:

1. Zone 1 (Roof Area Field): As required to meet wind loads
2. Zone 2 (Roof Area Perimeter): As required to meet wind loads

3. Zone 3 (Roof Area Corners): As required to meet wind loads

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-90.
2. Hail-Resistance Rating: FM Global Property Loss Prevention Data Sheet 1-34 MH.

E. ENERGY STAR Listing: Roofing system shall be listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for low-slope roof products.

F. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

2.2 THERMOPLASTIC POLYOLEFIN (TPO) ROOFING

A. TPO Sheet: ASTM D6878/D6878M, internally fabric- or scrim-reinforced, fabric-backed TPO sheet.
1. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.
2. Thickness: 60 mils, nominal.
3. Exposed Face Color: White.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Slip Sheet: Manufacturer's standard, of thickness required for application.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

H. Ballast Retaining Bar: Perimeter securement system consisting of a slotted extruded-aluminum retention bar with an integrated compression fastening strip.

1. Fasteners: 1-1/2-inch stainless steel fasteners with neoprene washers.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roof membrane manufacturer.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces.
1. Compressive Strength: 20 psi.
2. Size: 48 by 48 inches.
3. Thickness:

a. Base Layer: 1-1/2 inches.
b. Upper Layer: As required to meet R-value.

C. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.5 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners with metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate.

D. Cover Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M fiber-reinforced gypsum board.
   1. Thickness: 5/8 inch.
   2. Surface Finish: Factory primed.

E. as recommended by roofing system manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

   1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
   2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
   3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 053100 "Steel Decking."

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 INSTALLATION OF ROOFING, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, listed roof assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning Work on adjoining roofing.

C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 072726 "Fluid-Applied Membrane Air Barriers."

3.4 INSTALLATION OF INSULATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and roof insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.

    a. Locate end joints over crests of decking.
    b. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.
    c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

        1) Trim insulation so that water flow is unrestricted.

    f. Fill gaps exceeding 1/4 inch with insulation.
    g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
    h. Mechanically attach base layer of insulation using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.
        1) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

    a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
    b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    d. Fill gaps exceeding 1/4 inch with insulation.
    e. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

3.5 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

    a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.

3.6 INSTALLATION OF MECHANICALLY FASTENED ROOF MEMBRANE

A. Mechanically fasten roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. For in-splice attachment, install roof membrane with long dimension perpendicular to steel roof deck flutes.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Mechanically fasten or adhere roof membrane securely at terminations, penetrations, and perimeter of roofing.

F. Apply roof membrane with side laps shingled with slope of roof deck where possible.

G. In-Seam Attachment: Secure one edge of TPO sheet using fastening plates or metal battens centered within seam, and mechanically fasten TPO sheet to roof deck.

H. Seams: Clean seam areas, overlap roof membrane, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and flashing sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.7 INSTALLATION OF BASE FLASHING

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests or an acceptable approved alternate:

1. Flood Testing: Flood test each roof area for leaks, according to recommendations in ASTM D5957, after completing roofing and flashing but before overlying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

    a. Perform tests before overlying construction is placed.
    b. Flood to an average depth of 2-1/2 inches with a minimum depth of 1 inch and not exceeding a depth of 4 inches. Maintain 2 inches of clearance from top of base flashing.
    c. Flood each area for 24 hours.
    d. After flood testing, repair leaks, repeat flood tests, and make further repairs until roofing and flashing installations are watertight.

        1) Cost of retesting is Contractor's responsibility.

    e. Testing agency shall prepare survey report indicating locations of initial leaks, if any, and final survey report.

C. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.9 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing system, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.10 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: .
2. Address: .
3. Building Name/Type: .
4. Address: .
5. Area of Work: .
6. Acceptance Date: _____.
7. Warranty Period: .
8. Expiration Date: _____.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing Installer's own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. lightning;
    b. peak gust wind speed exceeding;
    c. fire;
    d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. vapor condensation on bottom of roofing; and
    g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075423

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufactured reglets with counterflashing.
2. Formed low-slope roof sheet metal fabrications.
3. Formed steep-slope roof sheet metal fabrications.
4. Formed wall sheet metal fabrications.
5. Formed equipment support flashing.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 04 20 00 "Unit Masonry" for materials and installation of manufactured sheet metal through-wall flashing and trim integral with masonry.
3. Section 07 41 13.16 “Standing-Seam Metal Roof Panels"" for materials and installation of sheet metal flashing and trim integral with roofing.
4. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings.

1.2 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following

1. Underlayment materials.
2. Elastomeric sealant.
3. Butyl sealant.
4. Epoxy seam sealer.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
10. Include details of special conditions.
11. Include details of connections to adjoining work.

C. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
4. Anodized Aluminum Samples: Samples to show full range to be expected for each color required.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

B. Special warranty.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.9 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

2.2 SHEET METALS

A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet in accordance with ASTM A653/A653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A755/A755M.
   1. Surface: Smooth, flat.
   2. Exposed Coil-Coated Finish:

      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

   3. Color: Match Architect's sample – Roofing Color.
   4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Synthetic Underlayment: Laminated or reinforced, woven polyethylene or polypropylene, synthetic roofing underlayment; bitumen free; slip resistant; suitable for high temperatures over 220 deg F; and complying with physical requirements of ASTM D226/D226M for Type I and Type II felts.

B. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
   1. Source Limitations: Obtain underlayment from single source from single manufacturer.
   2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

   1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

      a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
      b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
      c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
   2. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
   3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
   4. Fasteners for Zinc Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

H. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and with interlocking counterflashing on exterior face, of same metal as reglet.
   1. Source Limitations: Obtain reglets from single source from single manufacturer.
   2. Material: Stainless steel, 0.0188 inch thick or Galvanized steel, 0.022 inch thick.
   3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   4. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
   5. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
   6. Accessories:
      a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
      b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
   7. Finish: With manufacturer's standard color coating.

2.5 FABRICATION, GENERAL

A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
   1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
   2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
   3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
   4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
   5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.

B. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Galvanized Steel: 0.022 inch thick.

C. Flashing Receivers: Fabricate from the following materials:
1. Galvanized Steel: 0.022 inch thick.

D. Roof-Penetration Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

B. Valley Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

C. Drip Edges: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

E. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

F. Flashing Receivers: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

G. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

   1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.

1. Lap horizontal joints not less than 4 inches.
2. Lap end joints not less than 12 inches.

B. Self-Adhering, High-Temperature Sheet Underlayment:

1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
2. Prime substrate if recommended by underlayment manufacturer.
3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
6. Roll laps and edges with roller.
7. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.

1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of welds and sealant.
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.

8. Do not field cut sheet metal flashing and trim by torch.
9. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

E. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated.

a. Embed hooked flanges of joint members not less than 1 inch into sealant.
b. Form joints to completely conceal sealant.
c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
d. Adjust setting proportionately for installation at higher ambient temperatures.

1) Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.

1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
2. Do not solder metallic-coated steel and aluminum sheet.
3. Do not pretin zinc-tin alloy-coated copper.
4. Do not use torches for soldering.
5. Heat surfaces to receive solder, and flow solder into joint.

a. Fill joint completely.
b. Completely remove flux and spatter from exposed surfaces.

6. Stainless Steel Soldering:

a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
b. Promptly remove acid-flux residue from metal after tinning and soldering.
c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.4 INSTALLATION OF ROOF FLASHINGS

A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing 4 inches over base flashing.
3. Lap counterflashing joints minimum of 4 inches.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 INSTALLATION OF WALL FLASHINGS

A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

C. Reglets: Installation of reglets is specified in Section 042000 "Unit Masonry."

3.6 INSTALLATION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 CLEANING

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

3.8 PROTECTION

A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.

C. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 077100 – ROOF SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for downspout guards and downspout boots.
2. Section 061053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 074113.16 "Standing-Seam Metal Roof Panels" for roof-edge drainage-system components provided by metal-roof-panel manufacturer.
4. Section 076200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
5. Section 079200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

C. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
2. Include copings, roof-edge specialties, roof-edge drainage systems, reglets and counterflashings made from 12-inch lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of roof specialty.

C. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.

D. Sample Warranty: For manufacturer's special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
1. Build mockup of typical roof edge, including fascia, gutter and downspout, approximately 10 feet long, including supporting construction, seams, attachments, underlayment, and accessories.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 075419 PVC Roofing."

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

   a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install copings, roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

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. OMG, Inc. (Shadowline Coping)

2. Metallic-Coated Steel Sheet Coping Caps: Zinc-coated (galvanized) steel, nominal 0.028-inchthickness 24 Ga. Minimum or thickness as required to meet performance requirements.

a. Surface: Smooth, flat finish.
b. Finish: Two-coat fluoropolymer.
c. Color: As selected by Architect from manufacturer's full range.

3. Corners: Factory mitered and continuously welded.
4. Special Fabrications: Shadowline Coping.
5. Coping-Cap Attachment Method: Snap-on or face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.

a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.
b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

2.3 ROOF-EDGE DRAINAGE SYSTEMS

A. Gutters: Manufactured in uniform section lengths not exceeding 12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.

1. Zinc-Coated Steel: Nominal 0.028-inch thickness.
2. Gutter Profile: Style F according to SMACNA's "Architectural Sheet Metal Manual."
3. Corners: Factory mitered and continuously welded or mechanically clinched and sealed watertight.

4. Gutter Supports: Gutter brackets or Straps with finish matching the gutters.

B. Downspouts: Plain rectangular complete with machine-crimped elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.

1. Zinc-Coated Steel: Nominal 0.028-inch thickness.

C. Parapet Scuppers: Manufactured with closure flange trim to exterior, 4-inch-wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof.

1. Zinc-Coated Steel: Nominal 0.028-inch thickness.

D. Conductor Heads: Manufactured conductor heads, each with flanged back and stiffened top edge, and of dimensions and shape indicated, complete with outlet tube that nests into upper end of downspout, exterior flange trim,.

1. Zinc-Coated Steel: Nominal 0.028-inch thickness.

E. Zinc-Coated Steel Finish: Two-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.4 REGLETS AND COUNTERFLASHINGS

A. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.022-inch thickness.
2. Corners: Factory mitered and continuously welded or mechanically clinched and sealed watertight.
3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

B. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:

1. Zinc-Coated Steel: Nominal 0.022-inch thickness.

C. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.

2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

D. Zinc-Coated Steel Finish: Two-coat fluoropolymer.

1. Color: As selected by Architect from manufacturer's full range.

2.5 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 coating designation.

B. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304.

2.6 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: ASTM D1970/D1970M; stable after testing at 240 deg F.
2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A153/A153M or ASTM F2329.

B. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Galvanized-Steel Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A755/A755M and coating and resin manufacturers' written instructions.

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under copings, roof-edge specialties and reglets and counterflashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.3 INSTALLATION, GENERAL

A. Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of stainless steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.4 INSTALLATION OF COPINGS

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.
2. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

3.5 INSTALLATION OF ROOF-EDGE SPECIALITIES

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.6 INSTALLATION OF ROOF-EDGE DRAINAGE-SYSTEM

A. Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 12 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.

1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.

C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.
2. Connect downspouts to underground drainage system indicated.

D. Parapet Scuppers: Install scuppers through parapet where indicated. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal or solder exterior wall scupper flanges into back of conductor head.

E. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch below scupper discharge.

3.7 INSTALLATION OF REGLETS AND COUNTERFLASHINGS

A. Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: See Section 042000 "Unit Masonry" for installation of reglets.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.

D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 077100

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Penetration firestopping systems for the following applications:

a. Penetrations in fire-resistance-rated walls.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Approval according to FM Approval 4991, "Approval Standard for Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

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. 3M Fire Protection Products.
b. Hilti, Inc.

c. Specified Technologies, Inc.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E84.

D. Manufactured Piping Penetration Firestopping System: Penetration firestopping systems with ratings determined per ASTM E814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
2. Sleeve: Molded-PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
3. Stack Fitting: ASTM A48/A48M, gray-iron, hubless-pattern wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 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 the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
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 the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.

5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."

C. Penetration Firestopping Systems for Metallic Pipes, Conduit, or Tubing:
   1. F-Rating: 3 hours.
   2. Type of Fill Materials: As required to achieve rating.

D. Penetration Firestopping Systems for Nonmetallic Pipe, Conduit, or Tubing:
   1. F-Rating: 3 hours.
   2. Type of Fill Materials: As required to achieve rating.

E. Penetration Firestopping Systems for Electrical Cables:
   1. F-Rating: 3 hours.
   2. Type of Fill Materials: As required to achieve rating.

F. Penetration Firestopping Systems for Insulated Pipes:
   1. F-Rating: 3 hours.
   2. Type of Fill Materials: As required to achieve rating.

G. Penetration Firestopping Systems for Miscellaneous Mechanical Penetrants:
   1. F-Rating: 3 hours.
   2. Type of Fill Materials: As required to achieve rating.

H. Penetration Firestopping Systems for Groupings of Penetrants:
   1. F-Rating: 3 hours.
   2. Type of Fill Materials: As required to achieve rating.

END OF SECTION 078413

SECTION 078443 - JOINT FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints in smoke barriers.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
2. Section 092216 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:

    a. Joint firestopping systems shall bear classification marking of a qualified testing agency.

        1) UL in its "Fire Resistance Directory."
        2) Intertek Group in its "Directory of Listed Building Products."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E1966 or UL 2079.

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. 3M Fire Protection Products.
b. Hilti, Inc.
c. Specified Technologies, Inc.

2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E84.

D. Accessories: Provide components of joint firestopping systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing joint firestopping systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

3.3 INSTALLATION

A. General: Install joint firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for joint firestopping systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated joint firestopping systems immediately and install new materials to produce joint firestopping systems complying with specified requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

B. Wall-to-Wall, Joint Firestopping Systems:
   1. Assembly Rating: 3 hours.
   2. Nominal Joint Width: As indicated.

C. Floor-to-Wall, Joint Firestopping Systems:
   1. Assembly Rating: 3 hour.
   2. Nominal Joint Width: As indicated.

D. Head-of-Wall, Fire-Resistive Joint Firestopping Systems:
   1. Assembly Rating: 3 hour.
   2. Nominal Joint Width: As indicated.

END OF SECTION 078443

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silyl-terminated polyether joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

B. Related Requirements:
1. Section 321373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 100/50, NT: Single-component, nonsag, plus 100 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 100/50, Use NT.

B. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.

C. Silicone, Nonstaining, M, NS, 50, NT: Nonstaining, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type M, Grade NS, Class 50, Use NT.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Urethane, M, NS, 25, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Use NT.

C. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T and NT.

D. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T and NT.

E. Urethane, M, P, 50, T, NT: Multicomponent, pourable, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 50, Uses T and NT.

F. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

2.5 IMMERSIBLE JOINT SEALANTS

A. Urethane, Immersible, S, P, 25, T, NT, I: Immersible, single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T, NT, and I.

B. Polysulfide, Immersible, M, NS, 25, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, polysulfide joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses NT and I.

C. Urethane, Immersible, M, NS, 50, T, NT, I: Immersible, multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 50, Uses T, NT, and I.

D. Urethane, Immersible, M, NS, 25, T, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T, NT, and I.

E. Polysulfide, Immersible, M, NS, 25, T, NT, I: Immersible, multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, polysulfide joint sealant; ASTM C920, Type M, Grade NS, Class 25, Uses T, NT, and I.

F. Urethane, Immersible, M, P, 25, T, NT, I: Immersible, multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T, NT, and I.

2.6 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

2.7 POLYSULFIDE JOINT SEALANTS

A. Polysulfide, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, polysulfide joint sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT.

B. Polysulfide, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, polysulfide joint sealant; ASTM C920, Type M, Grade NS, Class 25, Use NT.

C. Polysulfide, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, polysulfide joint sealant; ASTM C920, Type M, Grade P, Class 25, Uses T and NT.

2.8 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C1311.

2.9 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C834, Type OP, Grade NF.

2.10 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C1330, Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.11 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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, 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 joint substrate 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. Porcelain enamel.
d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. 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 or primer 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.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint profile per Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

   a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

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 material, 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-Adhesion-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.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:

    a. Control and expansion joints in brick pavers.
    b. Isolation and contraction joints in cast-in-place concrete slabs.
    c. Joints between plant-precast architectural concrete paving units.
    d. Tile control and expansion joints.
    e. Joints between different materials listed above.
    f. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, P, 50, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Construction joints in cast-in-place concrete.
    b. Control and expansion joints in unit masonry.
    c. Joints between metal panels.
    d. Joints between different materials listed above.
    e. Perimeter joints between materials listed above and frames of doors, windows and louvers.
    f. Control and expansion joints in ceilings and other overhead surfaces.
    g. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

    a. Isolation joints in cast-in-place concrete slabs.
    b. Control and expansion joints in stone flooring.
    c. Control and expansion joints in brick flooring.
    d. Control and expansion joints in tile flooring.
    e. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, P, 25, T, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Control and expansion joints on exposed interior surfaces of exterior walls.
    b. Tile control and expansion joints.
    c. Vertical joints on exposed surfaces of unit masonry, walls and partitions.
    d. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

    a. Control joints on exposed interior surfaces of exterior walls.
    b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

    a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    b. Tile control and expansion joints where indicated.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

    a. Aluminum thresholds.
    b. Sill plates.
    c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As indicated by manufacturer's designations <**Insert color**>.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.

B. Related Requirements:
1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.

7. Details of anchorages, joints, field splices, and connections.
8. Details of accessories.
9. Details of moldings, removable stops, and glazing.

C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly and for tests performed by a qualified testing agency indicating compliance with performance requirements.

B. Field quality control reports.

1.6 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
d. Edge Construction: Model 1, Full Flush.
e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Core: Manufacturer's standard.
g. Fire-Rated Core: Manufacturer's standard core for fire-rated doors.

2. Frames:

a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
c. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.3 EXTERIOR STANDARD STEEL DOORS AND FRAMES

A. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A..

1. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches.
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
d. Edge Construction: Model 1, Full Flush.

e. Edge Bevel: Provide manufacturer's standard beveled or square edges.
f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
g. Bottom Edges: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
h. Core: Polyurethane.
i. Fire-Rated Core: Manufacturer's standard vertical steel stiffener with insulation core for fire-rated doors.

2. Frames:

a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A60 coating.
b. Construction: Full profile welded.

3. Exposed Finish: Prime.

2.4 BORROWED LITES

A. Fabricate of uncoated steel sheet, minimum thickness of 0.053 inch.

B. Construction: Full profile welded.

C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.

D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.5 HOLLOW-METAL PANELS

A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 feet.

3. Postinstalled Expansion Anchor: Minimum 3/8-inch-diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.

B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.

C. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.7 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.

E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.8 FABRICATION

A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.

1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding, or by rigid mechanical anchors.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

    a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

4. Terminated Stops (Hospital Stops): Terminate stops [**6 inches**] <**Insert dimension**> above finish floor with a [**45**] [**90**]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.

D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide stops and moldings flush with face of door, and with square stops unless otherwise indicated.
2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.9 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.10 LOUVERS

A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.

B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.

B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.

B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.

    a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
    b. Install frames with removable stops located on secure side of opening.

2. Fire-Rated Openings: Install frames according to NFPA 80.
3. Floor Anchors: Secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

4. Solidly pack mineral-fiber insulation inside frames.

5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors.
6. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.

1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Inspections:

1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081216 - ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior aluminum frames for doors installed in gypsum board partitions.
2. Interior aluminum frames for glazing installed in gypsum board partitions.
3. Interior aluminum doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles,and finishes.

B. Shop Drawings: For aluminum frames:

1. Include elevations, sections, and installation details for each wall-opening condition.
2. Include details for each frame type, including dimensioned profiles and metal thicknesses.
3. Include locations of reinforcements and preparations for hardware.
4. Include details of anchorages, joints, field splices, connections, and accessories.
5. Include details of moldings, removable stops, and glazing.

C. Samples for Verification: For each type of the following products:

1. Framing Member and Finish: 12 inches long. Include trim.
2. Corner Fabrication and Finish: 12-by-12-inch-long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.

D. Product Schedule: For aluminum frames. Use same designations indicated on Drawings. Coordinate with door hardware schedule and glazing.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain aluminum frames and frame-manufacturer's doors from single source from single manufacturer.

2.2 COMPONENTS

A. Aluminum Framing: ASTM B221, with alloy and temper required to suit structural and finish requirements, and not less than 0.062 inch thick.

B. Door Frames: Extruded aluminum, reinforced for hinges, strikes, and closers.

C. Glazing Frames: Extruded aluminum, for indicated glass thickness.

D. Door Tracks: Extruded aluminum where exposed, sized to enclose sliding-door hardware, and in finish matching frame and trim finish.

E. Trim: Extruded aluminum, not less than 0.062 inch thick; removable, snap-in casing trim, glazing stops and door stops, without exposed fasteners.

F. Doors: As specified in Section 081416 "Flush Wood Doors."

G. Doors: Manufacturer's standard, factory-assembled, 1-3/4-inch-thick, aluminum-framed door construction.

1. Door Operation: Swinging.
2. Stiles: Medium.
3. Rails: 6-inch top rail and 6-inch bottom rail.

H. Door Finish: Match frame and trim finish.

I. Frame and Trim Finish: Clear-anodized aluminum.

2.3 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals in gray color.

C. Glazing Gaskets: Manufacturer's standard extruded or molded rubber or plastic, to accommodate glazing thickness indicated; in gray.

D. Glass: As specified in Section 088000 "Glazing."

E. Door Hardware: As specified in Section 087100 "Door Hardware."

2.4 FABRICATION

A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted and mitered connections.

B. Factory prepare aluminum frames to receive templated mortised hardware; include cutouts, reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Section 087100 "Door Hardware."

1. Locate hardware cutouts and reinforcements as required by fire-rated label for assembly.

C. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.

1. Locate removable stops on the inside of spaces accessed by keyed doors.

D. Fabricate components to allow secure installation without exposed fasteners.

2.5 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that wall thickness does not exceed standard tolerances allowed by throat size of indicated aluminum frame.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.

B. Install frame components in the longest possible lengths with no piece less than 48 inches; components 96 inches or shorter shall be one piece.
   1. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
   2. Secure clips to extruded main-frame components and not to snap-in or trim members.
   3. Do not leave screws or other fasteners exposed to view when installation is complete.

C. Glass: Install glass according to Section 088000 "Glazing" and aluminum-frame manufacturer's written instructions.

D. Doors: Install doors aligned with frames and fitted with required hardware.

E. Door Hardware: Install according to Section 087100 "Door Hardware" and aluminum-frame manufacturer's written instructions.

3.3 ADJUSTING

A. Inspect installation, correct misalignments, and tighten loose connections.

B. Doors: Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly, and lubricate as recommended by manufacturer.

C. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 & 610.

D. Touch Up: Repair marred frame surfaces to blend inconspicuously with adjacent unrepaired surface as viewed by Architect. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081216

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid-core flush wood doors with plastic-laminate-faces.

B. Related Requirements:
   1. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

   1. Door core materials and construction.
   2. Door edge construction
   3. Door face type and characteristics.
   4. Door louvers.
   5. Door trim for openings.
   6. Door frame construction.
   7. Factory-machining criteria.
   8. Factory- finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

   1. Door schedule indicating door location, type, size, fire protection rating, and swing.
   2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
   3. Details of frame for each frame type, including dimensions and profile.
   4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
   5. Dimensions and locations of blocking for hardware attachment.
   6. Dimensions and locations of mortises and holes for hardware.
   7. Clearances and undercuts.
   8. Requirements for veneer matching.
   9. Doors to be factory finished and application requirements.

C. Samples for Verification:

1. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
2. Louver blade and frame sections, 6 inches long, for each material and finish specified.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Special warranties.

B. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in plastic bags or cardboard cartons.

C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Delamination of veneer.
b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 SOLID-CORE FLUSH WOOD DOORS AND TRANSOM PANELS WITH PLASTIC-LAMINATE FACES

A. Interior Doors:
1. Performance Grade:
a. ANSI/WDMA I.S. 1A Extra Heavy Duty: and where indicated on Drawings.

2. Architectural Woodwork Standards Grade: Premium.
3. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
4. Colors, Patterns, and Finishes: As selected by Architect from laminate manufacturer's full range of products.
5. Exposed Vertical and Top Edges: Plastic laminate that matches faces, applied before faces.
1) Finish steel edges and astragals to match door hardware (locksets or exit devices).

b. Mineral-Core Doors: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

1) Screw-Holding Capability: 550 lbf in accordance with WDMA T.M. 10.

6. Core for Non-Fire-Rated Doors:

a. Either glued wood stave or WDMA I.S. 10 structural composite lumber.

2.3 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
5. Metal Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

C. Transom and Side Panels:

1. Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors.
2. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
3. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.

D. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
3. Louvers: Factory install louvers in prepared openings.

2.4 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing.

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
2. Finish faces, all four edges, edges of cutouts, and mortises.
3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Install doors and frames to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Job-Fitted Doors:

1. Align and fit doors in frames with uniform clearances and bevels as indicated below.

    a. Do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors.

2. Machine doors for hardware.
3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
4. Clearances:

    a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.
    c. Where threshold is shown or scheduled, provide1/4 inch from bottom of door to top of threshold unless otherwise indicated.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 FIELD QUALITY CONTROL

A. Inspection Agency: Engage a qualified inspector to perform inspections and to furnish reports to Architect.

B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, fire ratings, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples: For each type of access door and frame and for each finish specified, complete assembly minimum 6 by 6 inches in size.

C. Product Schedule: For access doors and frames.

1.3 CLOSEOUT SUBMITTALS

A. Record Documents: For fire-rated doors, list of applicable room name and number in which access door is located.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:
1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Optional Features: Piano hinges.
3. Locations: Wall and ceiling.
4. Door Size: As required.
5. Uncoated Steel Sheet for Door: Nominal 0.060 inch, 16 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Cam latch, screwdriver operated.

B. Exterior Flush Access Doors:

1. Description: Weatherproof assembly, with face of door fit flush with frame and with exposed frame. Include extruded door gaskets and minimum 2-inch-thick fiberglass insulation.
2. Optional Features: Piano hinges.
3. Locations: Wall.
4. Door Size: As required.
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch, 16 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Cam latch operated by handle, with separate mortise lock.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A36/A36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A879/A879M, with cold-rolled steel sheet substrate complying with ASTM A1008/A1008M, Commercial Steel (CS), exposed.

C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

D. Frame Anchors: Same material as door face.

E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.

1. For concealed flanges with drywall bead, provide edge trim for gypsum panels securely attached to perimeter of frames.

D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling. Provide access sleeves for each latch operator and install in holes cut through finish.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

3.3 FIELD QUALITY CONTROL

A. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

B. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION 083113

SECTION 083323 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Service doors.

B. Related Requirements:

   1. Section 055000 "Metal Fabrications" for miscellaneous steel supports, door-opening framing, corner guards, and bollards.

1.2 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

   1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
   4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
   5. Show locations of controls, locking devices, and other accessories.
   6. Include diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

   1. Curtain slats, including full vision window secured to slat.
   2. Bottom bar with sensor edge.
   3. Guides.
   4. Brackets.
   5. Hood.
   6. Locking device(s).
   7. Include similar Samples of accessories involving color selection.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Special warranty.

B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling-door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:

1. Design Wind Load: As indicated on Drawings.

2.3 DOOR ASSEMBLY

A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 1.0 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.

D. Door Curtain Material: Galvanized steel.

E. Door Curtain Slats: Curved profile slats of 1-7/8-inch center-to-center height.

F. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.

G. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

H. Hood: Match curtain material and finish.

1. Shape: Round.
2. Mounting: Face of wall.

I. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: locking bars, operable from inside and outside with cylinders.

J. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Top of hood.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use.
4. Motor Exposure: Interior.
5. Motor Electrical Characteristics:

    a. Horsepower: 1/2 hp.
    b. Voltage: 208 V ac, three phase, 60 Hz. Verify on electrical panel schedule

6. Emergency Manual Operation: Chain type.
7. Obstruction-Detection Device: Automatic photoelectric sensor.

8. Control Station(s): Interior mounted.

K. Curtain Accessories: Equip door with weatherseals.

L. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Factory Prime Finish: Manufacturer's standard color.
3. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.
a. Lock Cylinders: As specified in Section 087100 "Door Hardware".
b. Keys: Three for each cylinder.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

2.7 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

B. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: As specified in Section 087100 "Door Hardware" and keyed to building keying system.
2. Keys: Three for each cylinder.

C. Chain Lock Keeper: Suitable for padlock.

D. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

2.9 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

D. Motors: Reversible-type motor for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensing device. When self-monitoring feature is activated, door closes only with sustained or constant pressure on close button.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

2.11 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.12 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.

D. Power-Operated Doors: Install according to UL 325.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and to furnish reports to Architect.

B. Perform the following tests and inspections:

1. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
2. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.

C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.

D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.5 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

1. Adjust exterior doors and components to be weather resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.6 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance, including emergency callback service, during normal working hours.
2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION 083323

SECTION 083613 - SECTIONAL DOORS

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. Sectional-door assemblies.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

1. Glazing.
2. Metal for door sections.
3. Hardware.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranties: For manufacturer's warranty and finish warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sectional doors to include in maintenance manuals.

B. Manufacturer's warranty.

C. Finish warranty.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including, but not limited to, excessive deflection.
    b. Failure of components or operators before reaching required number of operation cycles.
    c. Faulty operation of hardware.
    d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
    e. Delamination of exterior or interior facing materials.

2. Warranty Period: Five years from date of Substantial Completion.

B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction.

B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.
2. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.

    a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
    b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
3. Garage-Door Glazed Openings: Pass DASMA 115.

2.3 SECTIONAL-DOOR ASSEMBLY

A. Aluminum Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.

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. Wayne-Dalton Corp (K-AL Series Aluminum doors).

B. Operation Cycles: Door components and operators capable of operating for not less than 10,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.

C. R-Value: 4.25 door, 3.9 glass minimum.

D. Aluminum Sections: ASTM B221 extruded-aluminum stile and rail members of alloy and temper standard with manufacturer for type of use and finish indicated;; with rail and stile dimensions and profiles indicated on Drawings; and with overlapped or interlocked weather- and pinch-resistant seal at meeting rails.

1. Door-Section Thickness: 2 inches.
2. Section Reinforcing: Continuous horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Ensure that reinforcement does not obstruct vision lites.

    a. Hardware Locations: Provide reinforcement for hardware attachment.

3. Insulated Stiles and Rails: Fill stiles and rails manufacturer's standard polyurethane expanding foam.
4. Glazed Panels: Manufacturer's standard, aluminum-framed section with glazing sealed with glazing tape and aluminum glazing bead. Glazing as follows:
    a. Insulating Glass Units: Manufacturers' standard unit with tempered glass lites complying with ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (clear), Quality-Q3.

5. Solid Aluminum Panels: ASTM B209, alloy and temper standard with manufacturer for use and finish indicated.

    a. Description: 1/2-inch-thick overall insulated panel composed of 0.050-inch aluminum interior and exterior panels with an extruded polystyrene (EPS) core.
    b. Attachment to Frame: Sealed with glazing tape and aluminum glazing bead.
    c. Aluminum Surface: Smooth.

E. Track: Manufacturer's standard, galvanized-steel, standard-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.

1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.

    a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide continuous angle attached to track and wall.
    b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.

F. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door. Provide combination bottom weatherseal and sensor edge for bottom seal.

G. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:
1. Insulating Glass Units: Manufacturer's standard ½”low e insulated clear and satin-etched.

H. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.

1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.

a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.

2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.

a. Roller-Tire Material: Manufacturer's standard.

I. Locking Device:

1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

2. Chain Lock Keeper: Suitable for padlock.
3. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

J. Counterbalance Mechanism:

1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.

a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
b. Provide one additional midpoint bracket for shafts up to 16 ft. long and two additional brackets at one-third points to support shafts more than 16 ft. long unless closer spacing is recommended in writing by door manufacturer.

K. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.

2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
3. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use.
4. Usage Classification: Medium duty, up to 25 cycles per hour and up to 90 cycles per day.
5. Operator Type: Manufacturer's standard for door requirements.
6. Motor: Reversible-type for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.

    a. Motor Size: As required to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
    b. Electrical Characteristics:

        1) Phase: Polyphase.
        2) Volts: 208 V.

7. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
8. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
    a. Unmonitored Entrapment Protection: Pneumatic sensor edge, black, located within weatherseal mounted to bottom bar.

9. Control Station: Surface mounted, three-position (open, close, and stop) control.

    a. Operation: Push button.
    b. Interior-Mounted Unit: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
    c. Features: Provide the following:

        1) Vehicle detection operation.
        2) Radio-control operation.
        3) Card-reader control.
        4) Photocell operation.
        5) Door-timer operation.
        6) Explosion- and dust-ignition-proof control wiring.
        7) Audible and visual signals that comply with regulatory requirements for accessibility.

10. Emergency Manual Operation: Chain type designed so required force for door operation does not exceed 25 lbf.
11. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

12. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

L. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
1. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

a. Aluminum Finish: Comply with AAMA 2603 requirements for pigmented organic coatings applied to aluminum extrusions and panels.
b. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Power-Operated Doors: Install in accordance with UL 325.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.

D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

END OF SECTION 083613

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Aluminum-framed storefront systems.
2. Aluminum-framed entrance door systems.
3. Aluminum Sunshades

B. Related Requirements:
1. Section 081216 "Aluminum Frames" for interior aluminum framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.
f. Aluminum suncreens

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
4. Include point-to-point wiring diagrams showing the following:

a. Power requirements for each electrically operated door hardware.
b. Location and types of switches, signal device, conduit sizes, and number and size of wires.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Installer.
2. For professional engineer's experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the jurisdiction in which Project is located.

B. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

C. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Source quality-control reports.

E. Field quality-control reports.

F. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C1401 recommendations for post-installation-phase quality-control program.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

B. Testing Agency Qualifications: Qualified according to ASTM E699 for testing indicated and acceptable to Owner and Architect.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1.7 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures, including, but not limited to, excessive deflection.

b. Noise or vibration created by wind and thermal and structural movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Water penetration through fixed glazing and framing areas.
e. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans of up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches.

E. Water Penetration under Static Pressure: Test according to ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft..

F. Energy Performance: Certified and labeled by manufacturer for energy performance as follows:

1. Thermal Transmittance (U-factor):

a. Fixed Glazing and Framing Areas: U-factor for the system of not more than 0.46 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
b. Entrance Doors: U-factor of not more than 0.77 Btu/sq. ft. x h x deg F as determined according to NFRC 100.

2. Solar Heat-Gain Coefficient (SHGC):

a. Fixed Glazing and Framing Areas: SHGC for the system of not more than 0.25 as determined according to NFRC 200.
b. Entrance Doors: SHGC of not more than 0.25 as determined according to NFRC 200.

3. Air Leakage:

a. Fixed Glazing and Framing Areas: Air leakage for the system of not more than 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft. when tested according to ASTM E283.
b. Entrance Doors: Air leakage of not more than [**1.0 cfm/sq. ft.**] at a static-air-pressure differential of 1.57 lbf/sq. ft..

4. Condensation Resistance Factor (CRF):

a. Fixed Glazing and Framing Areas: CRF for the system of not less than 70 as determined according to AAMA 1503.

G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
    b. Low Exterior Ambient-Air Temperature: 0 deg F.
    c. Interior Ambient-Air Temperature: 75 deg F.

2.3 STOREFRONT SYSTEMS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. Kawneer North America, an Arconic company; Trifab Versaglaze 601T.
2. Oldcastle BuildingEnvelope (OBE); CRH Americas; Series 6000 Thermal MultiPlane.

B. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction: Thermally broken.
2. Interior Vestibule Framing Construction: Nonthermal.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Glazing Plane: Front.
5. Finish: High-performance organic finish.
6. Fabrication Method: Field-fabricated stick system.
7. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
8. Steel Reinforcement: As required by manufacturer.

C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.

1. Door Construction: 2-inch overall thickness, with minimum 0.188-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

    a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Medium stile; 3-1/2-inch nominal width.

3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

    a. Provide nonremovable glazing stops on outside of door.

4. Finish: Match adjacent storefront framing finish.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:

    a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion.
    b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

2.6 SUNSHADES

A. Take accurate field measurements to verify required dimensions prior to fabrication.

B. Location of exposed joints is subject to Architect’s approval.

C. Fabricate components in accord with approved shop drawings. Remove burrs and ease edges. Shop fabricate to greatest extent practicable to minimize field cutting, splicing, and assembly. Disassemble only to extent necessary for shipping and handling limitations.

D. Conceal fasteners wherever possible.

E. Sunshade system is comprised of wall anchors, outriggers, louvers and fascia that are anchored directly to the Curtain Wall intermediate vertical members or building substrate.

F. Fabricate components true to detail and free from defects impairing appearance, strength or durability.

G. Fabricate components to allow for accurate and rigid fit of joints and corners. Match components carefully ensuring continuity of line and design. Ensure joints and connections will be flush. Overall projection depth of 36” maximum shall be as detailed on architectural drawings.

H. Outriggers shall be painted

I. Select from any of manufacture standard paint finishes

J. Wall anchors shall be painted
   1. Select from any of manufacture standard paint finishes

K. Louvers, plates, fascia and componenents shall be painted
   1. Select from any of manufacture standard paint finishes

L. Engineering: Sun shade system must be engineered to support all structural loads required for the project. The anchors and curtain wall system must be engineered to withstand all loads transferred from the sun shade system.

2.7 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

D. Weatherseal Sealants: ASTM C920 for Type S; Grade NS; Class 25; Uses NT, G, A, and O; chemically curing silicone formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and structural-sealant-glazed storefront manufacturers for this use.

   1. Color: Match structural sealant.

2.8 MATERIALS

A. Sheet and Plate: ASTM B209.

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.

C. Structural Profiles: ASTM B308/B308M.

D. Steel Reinforcement:

   1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
   2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
   3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.

E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

2.9 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A123/A123M or ASTM A153/A153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

E. Rigid PVC Filler.

2.10 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At interior and exterior doors, provide compression weather stripping at fixed stops.

F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.11 ALUMINUM FINISHES

A. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with AAMA 2604 and containing not less than 70 percent PVDF resin by weight in color coat.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Set continuous sill members and flashing in full sealant bed, as specified in Section 079200 "Joint Sealants," to produce weathertight installation.

I. Install joint filler behind sealant as recommended by sealant manufacturer.

J. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

A. Install glazing as specified in Section 088000 "Glazing."

3.4 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

A. Install entrance doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.5 ERECTION TOLERANCES

A. Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on mockups.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of two tests in areas as directed by Architect.

2. Air Leakage: ASTM E783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

    a. Perform a minimum of two tests in areas as directed by Architect.

3. Water Penetration: ASTM E1105 at a minimum uniform static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and shall not evidence water penetration.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 08 71 00
DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

A. This section includes the following:
   1. Commercial door hardware.
   2. Electrified door hardware.

1.02 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Details of electrified door hardware, including wiring diagrams.

C. Other Action Submittals:
   1. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.
      a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
      b. The Finishing Hardware Schedule is to follow the guidelines and format as set forth in the DHI publication “Scheduling Sequence and Scheduling Format”.
      c. Content: Include the following information:
         1) Identification number, location, hand, fire rating and material of each door and frame.
         2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
         3) Complete designations of every item required for each door or opening including name and manufacturer.
         4) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

B. Supplier Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252

D. Electric Hardware:

1. Unless noted otherwise in Division 16 or Division 28, furnish electric hardware items that operate at 24 VDC.
2. Coordinate electrical hardware requirements with Division 16 and Division 28 work for electrical distribution, fire alarm, and security systems.

PART 2 PRODUCTS

2.01 MANUFACTURES

A. Source Limitations: Obtain all products from a single manufacturer. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Allegion, (Basis of Design)
2. Assa Abloy
3. Dormakaba

2.02 SCHEDULED DOOR HARDWARE

A. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3.2 "Door Hardware Sets". Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required.
2. Hardware set designations are standard throughout all projects. Use hardware set names as listed in Part 3.2. Do not renumber hardware sets.

B. Notwithstanding anything to the contrary herein, to the greatest extend possible all manufacturers and model numbers for electrified door hardware within a given building shall match.

2.03 ELECTRIFIED HARDWARE AND WIRING HARNESSES

A. Door hardware may be electrified either at the specified lockset, exit device, and hinge manufacturer’s factory, or by a 3rd-party manufacturer who modifies specified locksets, exit devices and hinges for compatibility with 3rd-party wiring harnesses.

B. All electrified door hardware sets shall include a factory standard wiring harness system to allow for simple connections between electrified locksets / exit devices to electrified transfer hinges, and from electrified transfer hinges to a junction box above the door location.

C. All electrified door hardware components including electrified mortise locksets, electrified exit devices, electric transfer hinges, and any other electrified hardware shall incorporate factory-installed quick-connect Molex connectors.

D. Manufacturers:

1. Allegion (Using Allegion Connect harnesses from Allegion factory for Schlage, Von Duprin, and Ives hardware)
2. Architectural Control Systems Incorporated (ACSI) (Modification of Schlage, Von Duprin, and Hager products for compatibility with McKinney Electrolynx harnesses)

2.04 HINGES, GENERAL

A. No removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed. Furnish at all reverse beveled locked doors.

2.05 HINGES

A. Butts and Hinges: BHMA A156.1.

B. Electric hinges to have quick connect Molex connectors.

C. Manufacturers:

1. Ives; Allegion (IVE)

2.06 CONTINUOUS HINGES

A. Continuous Hinges: BHMA 156.26.

B. Electric continuous hinges to have quick connect Molex connectors and removable module.

C. Manufacturer:

1. Ives; Allegion (Ives)

2.07 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101.

C. Electrified Locking Devices: BHMA A156.25.

D. Electric locks to have quick connect Molex connectors. Electric modification of specified locksets by a manufacturer that provides such services and products shall be acceptable.

E. Lock Trim:

1. Levers: Schlage 17A (Confirm with design and owner team).

F. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

G. Backset: 2-3/4 inches, unless otherwise indicated.

H. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

I. Provide electrified locksets only where card readers are required by the Security Consultant. Coordinate with Security Consultant drawings.

2.08 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:

1. Mortise Locks: BHMA A156.13.

B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13, Grade 1, Series 1000.

C. Manufacturers:

1. Schlage Lock Company; Allegion (SCH).

2.09 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks: BHMA A156.29, Grade 1, surface mounted, battery powered, housed in metal case; with red-and-white lettering reading "EMERGENCY EXIT PUSH TO OPEN--ALARM WILL SOUND."

B. Stand-Alone Exit Alarms: BHMA A156.29, Grade 1, mounted separate from door and activated by door movement switch.

C. Manufacturers:

1. Von Duprin; Allegion (VON).

2.10 DOOR BOLTS

A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

B. Delete options in two paragraphs below if grade is indicated in door hardware sets.

C. Dustproof Strikes: BHMA A156.16, Grade 1.

1. Manufacturers:
   a. Ives; Allegion (Ives).
   b. Furnish at all manual, automatic and self latching bolts.

D. Surface Bolts: BHMA A156.16, Grade 1.

1. Manufacturers:
   a. Ives; Allegion (IVE).

E. Manual Flush Bolts: BHMA A156.16, Grade 1; designed for mortising into door edge.

1. Manufacturers:
   a. Ives; Allegion (IVE).

F. Automatic and Self-Latching Flush Bolts: BHMA A156.3, Grade 1; designed for mortising into door edge.

1. Manufacturers:
   a. Ives; Allegion (IVE).

2.11 EXIT DEVICES

A. Exit Devices: BHMA A156.3, Grade 1.

B. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

D. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

E. Removable Mullions: BHMA A156.3.

F. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

1. All Mullions to be equipped with key removable feature.

G. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

1. Operation: Rigid.

H. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

I. Through Bolts: For exit devices and trim on metal doors.

J. Electric Exit Devices: Electric exit devices to have quick connect Molex connectors. Electric modification of specified locksets by a manufacturer that provides such services and products shall be acceptable.

K. Manufacturers:

1. Von Duprin; Allegion (VON).

2.12 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5, Grade 1.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Seven.
2. Cylinders to interchangeable core. Furnish brass construction core as specified in sets.
3. Permanent Cores: By owner.

C. Manufacturers:

1. Schlage Lock Company; Allegion (SCH).
2. Match existing system if required.

2.13 KEYING

A. Keying System: Temporary cores to be construction master keyed. Final keying of permanent cores by owner

2.14 CLOSERS

A. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 5 lbfto open door to minimum required width. Except exterior doors and fire doors which must positively latch.

B. Hold-Open Closers/Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.

C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4, Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

E. Manufacturers:

1. LCN Closers; Allegion (LCN)

2.15 PROTECTIVE TRIM UNITS

A. Size: 2 inchesless than door width on push side and 1inchless than door width on pull side, by height specified in door hardware sets.

B. Plates are to be .050 thick, with beveled 4 edges (B4E) and countersunk holes (CSK)

C. Manufacturer:

1. Ives; Allegion (IVE).

2.16 DOOR Gasketing

A. Standard: BHMA A156.22.

B. General: Provide continuous weather-strip gasketing on computer room and exterior doors, and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.

1. Provide smoke-labeled gasketing on 20-minute-rated doors and on smoke-labeled doors.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

G. Door Thresholds: Assure installation meets applicable accessibility requirements. Select threshold appropriate to wall thickness and floor conditions. Model number and manufacturers listed in Hardware Schedule intended as an example only.

H. Overlapping astragals are installed on the pull side of the active door for out swinging doors and on the push side of the inactive door on in swinging doors.

I. Manufacturers:

1. Zero; Allegion (ZER)

2.17 MISCELLANEOUS DOOR HARDWARE

A. Door stops: Install wall or floor mounted door stops where necessary to prevent door from hitting adjacent walls or other interferences.

B. Auxiliary Hardware: BHMA A156.16, Grade 1.

1. Manufacturers:
   a. Ives; Allegion (IVE).

2.18 ELECTRIC DOOR HARDWARE

A. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

B. Furnish wire harness in the doors for electric locks and exits and in the frame from the hinge to the ceiling above the frame.

C. Manufacturer:

1. Von Duprin; Allegion (VON)

2.19 MATERIAL FINISHES

A. All finishes as listed in the sets. Locks are US26D except the locks in the infrastructure yard wall which are US32D.

PART 3 EXECUTION:

3.01 INSTALLATION

A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

C. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

D. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.

E. Configuration: Provide one power supply for each door opening that requires a power supply other than 24V. All 24V to be provided by security contractor.

F. Comply with DHI "Recommended Locations for Builder's Hardware" and hardware manufacturers instructions.

3.02 HARDWARE SETS

47613 OPT0193012 Version 1
Hardware Group No. 001

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	MORTISE CYLINDER	20-061 W/CONST. CORE	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	NOTE	REMAINDER OF HARDWARE BY DOOR MFR.		

-Coordinate hardware with door MFR.

Hardware Group No. 103T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050T 17A L583-363	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 201

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 201CW

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 201W

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 205T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	8198AA LENGTH AS REQ	AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER

Hardware Group No. 207

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MOUNTING AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 210

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB51P/FB61P AS REQ	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
2	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
1	EA	MEETING STILE	8193AA (2 PCS - 1 SET) HEIGHT AS REQUIRED (OMIT @ NON-RATED DOORS)	AA	ZER

Hardware Group No. 212

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB51P/FB61P AS REQ	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
2	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	MEETING STILE	8193AA (2 PCS - 1 SET) HEIGHT AS REQUIRED (OMIT @ NON-RATED DOORS)	AA	ZER
2	EA	SILENCER	SR64	GRY	IVE

Hardware Group No. 214T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
2	EA	MANUAL FLUSH BOLT	FB458-12"	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	L9080T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MOUNTING AS REQ (Inactive Leaf)	630	GLY
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ (Active Leaf)	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	328AA H & J	AA	ZER
1	EA	MEETING STILE	8193AA (2 PCS - 1 SET) HEIGHT AS REQUIRED	AA	ZER
2	EA	DOOR SWEEP	8198AA LENGTH AS REQ	AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER

Hardware Group No. 407

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 17A	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MOUNTING AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 410S

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB51P/FB61P AS REQ	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	PASSAGE SET	L9010 17A	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MOUNTING AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
1	EA	MEETING STILE	8193AA (2 PCS - 1 SET) HEIGHT AS REQUIRED (OMIT @ NON-RATED DOORS)	AA	ZER

Hardware Group No. 501T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 503

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 507

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	L9070T 17A	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MOUNTING AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER

Hardware Group No. 701

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-L-17 LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	20-057 W/CONST. CORE	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
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. 731

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PANIC HARDWARE	99-L-BE-17 LENGTH AS REQ	626	VON
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
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. 801

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	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
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. 810A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	112XY HEIGHT AS REQ	628	IVE
2	EA	LONG DOOR PULL	PR 9266 36" (MOUNT BACK TO BACK)	630	IVE
2	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR.		
1	SET	ASTRAGAL	MEETING STILE SEAL BY DOOR MFR.		

Hardware Group No. 811T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
2	EA	LONG DOOR PULL	9266F 36" (MOUNT BACK TO BACK)	630	IVE
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
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. C201

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 MORTISE LOCK	L9092T EU 17A RX CON (FAIL SECURE)	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
2	EA	HARNESS (1 IN DOOR & 1 IN FRAME)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY ANOTHER SECTION 1		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CREDENTIAL READER BY ANOTHER SECTION		
1	EA	POWER SUPPLY	PS902 120/240 VAC (COORDINATE PS WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS)	LGR	SCE

-INGRESS BY THE CARD READER OR KEY OVERRIDE.
-FREE EGRESS BY LEVER.

Hardware Group No. C207

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 MORTISE LOCK	L9092T EU 17A RX CON (FAIL SECURE)	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MOUNTING AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J (USE SILENCERS @ NON-RATED DOORS)	BK	ZER
2	EA	HARNESS (1 IN DOOR & 1 IN FRAME)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY ANOTHER SECTION 1		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CREDENTIAL READER BY ANOTHER SECTION		
1	EA	POWER SUPPLY	PS902 120/240 VAC (COORDINATE PS WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS)	LGR	SCE

-INGRESS BY THE CARD READER OR KEY OVERRIDE.
-FREE EGRESS BY LEVER.

Hardware Group No. C207GT

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	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 MORTISE LOCK	L9092T EU 17A RX CON (FAIL SECURE)	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	OH STOP	100S SERIES X SIZE & MOUNTING AS REQ	630	GLY
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488S PSA H & J	BK	ZER
1	EA	DOOR BOTTOM	364AA-Z49 LENGTH AS REQ	AA	ZER
2	EA	HARNESS (1 IN DOOR & 1 IN FRAME)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY ANOTHER SECTION 1		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CREDENTIAL READER BY ANOTHER SECTION		
1	EA	POWER SUPPLY	PS902 120/240 VAC (COORDINATE PS WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS)	LGR	SCE

-INGRESS BY THE CARD READER OR KEY OVERRIDE.
-FREE EGRESS BY LEVER.

Hardware Group No. C214T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
7	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
2	EA	MANUAL FLUSH BOLT	FB458-12"	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	EU MORTISE LOCK	L9092T EU 17A RX CON (FAIL SECURE)	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	OH STOP	900S SERIES X SIZE & MOUNTING AS REQ (Inactive Leaf)	630	GLY
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ (Active Leaf)	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	328AA H & J	AA	ZER
1	EA	MEETING STILE	8193AA (2 PCS - 1 SET) HEIGHT AS REQUIRED	AA	ZER
2	EA	DOOR SWEEP	8198AA LENGTH AS REQ	AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER
2	EA	HARNESS (1 IN DOOR & 1 IN FRAME)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY ANOTHER SECTION 1		
2	EA	DOOR CONTACT	679-05 TYPE AS REQ	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CREDENTIAL READER BY ANOTHER SECTION		
1	EA	POWER SUPPLY	PS902 120/240 VAC (COORDINATE PS WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS)	LGR	SCE

-INGRESS BY THE CARD READER OR KEY OVERRIDE.
-FREE EGRESS BY LEVER.

Hardware Group No. C701

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	652	IVE
1	EA	ELEC PANIC HARDWARE	RX-99-L-M996-17-FSE-CON (FAIL SECURE) LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	20-057 W/CONST. CORE	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP RW/PA X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
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
2	EA	HARNESS (1 IN DOOR & 1 IN FRAME)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY ANOTHER SECTION 1		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CREDENTIAL READER BY ANOTHER SECTION		
1	EA	POWER SUPPLY	PS902 120/240 VAC (COORDINATE PS WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS)	LGR	SCE

-INGRESS BY THE CARD READER OR KEY OVERRIDE.
-FREE EGRESS BY THE PUSH PAD.

Hardware Group No. C715A

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	112XY EPT HEIGHT AS REQ	628	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-33A-NL-OP-CON LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	20-057 W/CONST. CORE	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	90 DEG OFFSET PULL	8190-O 10"	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	SET	SEAL	PERIMETER SEAL BY FRAME MFR.		
1	EA	DOOR SWEEP	8198AA LENGTH AS REQ	AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER
2	EA	HARNESS (1 IN DOOR & 1 IN FRAME)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY ANOTHER SECTION 1		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CREDENTIAL READER BY ANOTHER SECTION		
1	EA	POWER SUPPLY	PS902 120/240 VAC (COORDINATE PS WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS)	LGR	SCE

-INGRESS BY THE CARD READER OR KEY OVERRIDE.
-FREE EGRESS BY THE PUSH PAD.

Hardware Group No. C715T

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	ELEC PANIC HARDWARE	RX-QEL-99-NL-CON LENGTH AS REQ	626	VON
1	EA	RIM CYLINDER	20-057 W/CONST. CORE	626	SCH
1	EA	PERMANENT CORE	CONFRIM W/OWNER (MATCH EXISTING SYSTEM AS REQ.)	626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH X MTG BRKT, SPCR & PLATE AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142A DW + 4"	AA	ZER
1	EA	GASKETING	328AA H & J	AA	ZER
1	EA	DOOR SWEEP	8198AA LENGTH AS REQ	AA	ZER
1	EA	THRESHOLD	65A LENGTH AS REQ	A	ZER
2	EA	HARNESS (1 IN DOOR & 1 IN FRAME)	ALLEGION CONNECT TYPE & LENGTH AS REQ		SCH
1	EA	HARNESS (TO POWER SUPPLY)	CON-6W - CONNECTION LEADS		SCH
1	EA	CREDENTIAL READER	CREDENTIAL READER BY ANOTHER SECTION 1		
1	EA	DOOR CONTACT	679-05 TYPE AS REQ	WHT	SCE
1	EA	POWER SUPPLY	POWER SUPPLY FOR CREDENTIAL READER BY ANOTHER SECTION		
1	EA	POWER SUPPLY	PS902 120/240 VAC (COORDINATE PS WITH SECURITY CONTRACTOR PRIOR TO SUBMITTALS)	LGR	SCE

-INGRESS BY THE CARD READER OR KEY OVERRIDE.
-FREE EGRESS BY THE PUSH PAD.

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SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing sealants.
4. Glazing tapes.
5. Miscellaneous glazing materials.

B. Related Requirements:
1. Section 088300 "Mirrors."

1.2 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.3 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches square.
   1. Insulating glass.

C. Glazing Accessory Samples: For sealants, in 12-inch lengths.

D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturers of fabricated glass units.

B. Product Certificates: For glass.

C. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

D. Preconstruction adhesion and compatibility test report.

E. Sample Warranties: For special warranties.

1.7 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain tinted and coated glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings.

a. Wind Design Data: As indicated on Drawings.

2. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick minimum.
2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
4. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
5. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. AAMA Publications: AAMA GDSG-1, "Glass Design for Sloped Glazing," and AAMA TIR A7, "Sloped Glazing Guidelines."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than thickness indicated.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C1036, Type I, Class 2 (tinted), Quality-Q3.

C. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

E. Reflective- and Low-E-Coated Vision Glass: ASTM C1376.

F. Ceramic-Coated Vision Glass: ASTM C1048, Condition C, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3; and complying with Specification No. 95-1-31 in NGA's "Engineering Standards Manual."

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Manufacturer's standard spacer material and construction.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range of industry colors.

B. Neutral-Curing Silicone Glazing Sealant, Class 100/50: Complying with ASTM C920, Type S, Grade NS, Use NT.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. EPDM with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. EPDM with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to 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.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.8 MONOLITHIC GLASS SCHEDULE

A. Clear Glass Type: Fully tempered float glass.

1. Minimum Thickness: 6 mm.
2. Safety glazing required.

3.9 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Glass Type:

1. Basis-of-Design Product: Solarban 90.
2. Overall Unit Thickness: 1 inch.
3. Minimum Thickness of Each Glass Lite: 6 mm.
4. Outdoor Lite: heat-strengthened float glass. (To be verified for each location.)
5. Interspace Content: Air.
6. Indoor Lite: Clear fully tempered float glass. (To be verified for each location.)
7. Low-E Coating: Pyrolytic on second surface.
8. Winter Nighttime U-Factor: 0.29 maximum.
9. Summer Daytime U-Factor: 0.46 maximum.
10. Visible Light Transmittance: 51 percent minimum.
11. SGHC: 0.23 maximum.
12. Safety glazing required.

END OF SECTION 088000

SECTION 088300 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silvered flat glass mirrors.

B. Related Requirements:

1. Section 088000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
2. Section 102800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Mirrors: Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

C. Samples: For each type of the following:

1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.
2. Mirror Clips: Full size.
3. Mirror Trim: 12 inches long.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of mirror and mirror mastic.

C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Installer, who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors in accordance with mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C1503.

B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear.

1. Nominal Thickness: 5.0 mm.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

D. Film Backing for Safety Mirrors: Film backing and pressure-sensitive adhesive; both compatible with mirror backing paint as certified by mirror manufacturer.

2.3 MIRROR HARDWARE

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Aluminum J Channel Bottom and Side Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.

2. Aluminum J Channel Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.

3. Finish: Clear bright anodized.

B. Plated Steel Hardware: Formed-steel shapes with plated finish indicated.

1. Profile: As indicated.

C. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

D. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.4 FABRICATION

A. Shop fabricate mirrors to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts, so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Rounded polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.

2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced National Glass Association (NGA) publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

1. NGA Publications: "Glazing Manual" and "Installation Techniques Designed to Prolong the Life of Flat Glass Mirrors."

B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
2. Install mastic as follows:

a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.

c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

3.3 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer and NGA's publication "Proper Procedures for Cleaning Flat Glass Mirrors."

END OF SECTION 088300

SECTION 089119 - FIXED LOUVERS

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. Fixed extruded-aluminum louvers.
2. Blank-off panels for louvers

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
2. Section 099123 "Interior Painting" for field painting interior louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Sample Warranties: For manufacturer's special warranties.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 WARRANTY

A. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fixed louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.

1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

B. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louver :
1. Louver Depth: 6 inches.
2. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
3. Mullion Type: Exposed.

4. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening, except where insect screening is indicated.

B. Secure screen frames to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Mill finish unless otherwise indicated.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:
   1. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

2.5 BLANK-OFF PANELS

A. Uninsulated Blank-Off Panels: Metal sheet attached to back of louver.

   1. Aluminum sheet for aluminum louvers, not less than 0.050-inch nominal thickness.
   2. Panel Finish: Same finish applied to louvers.
   3. Attach blank-off panels with clips.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A653/A653M, G60 zinc coating, mill phosphatized.

D. Fasteners: Use types and sizes to suit unit installation conditions.

   1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
   2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
   3. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless-steel fasteners.
   4. For color-finished louvers, use fasteners with heads that match color of louvers.

E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless-steel components, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing according to ASTM E488/E488M conducted by a qualified testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.7 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Provide subsills made of same material as louvers or extended sills for recessed louvers.

2.8 ALUMINUM FINISHES

A. Finish louvers after assembly.
1. Color: Match Architect's sample.

B. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of code-compliance certification for studs and tracks.

B. Evaluation Reports: For embossed, high-strength steel studs and tracks, firestop tracks, post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

C. Horizontal Deflection: For composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft..

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.

B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.

1. Steel Studs and Tracks:
   a. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection.
   b. Depth: As indicated on Drawings.

2. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.
   a. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements.
   b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch minimum vertical movement.
2. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
3. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Steel Thickness: 0.0269 inch.

F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: 1-1/2 inches.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
   1. Minimum Base-Steel Thickness: As indicated on Drawings.
   2. Depth: As indicated on Drawings.

H. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
   1. Configuration: Asymmetrical or hat shaped.

I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

   1. Depth: As indicated on Drawings.
   2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
   3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

D. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.

   1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
2. Steel Studs and Tracks: ASTM C645.

    a. Minimum Base-Steel Thickness: 0.0329 inch.
    b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.

    a. Minimum Base-Steel Thickness: 0.0329 inch.

4. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.

    a. Configuration: Asymmetrical or hat shaped.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Installation Standard: ASTM C754.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.

B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.3 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

    a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:

a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:

1. Screw to wood framing.
2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 INSTALLING CEILING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure 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 suspension system.

a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension

system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Gypsum wallboard.
2. Gypsum board, Type X.
3. Gypsum ceiling board.
4. Impact-resistant gypsum board.
5. Glass-mat interior gypsum board.
6. Glass-mat, water-resistant backing board.
7. Interior trim.
8. Exterior trim.
9. Aluminum trim.
10. Joint treatment materials.
11. Laminating adhesive.
12. Sound-attenuation blankets.
13. Acoustical sealant.
14. Textured finishes.

1.3 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C1396/C1396M.

B. Gypsum Board, Type X: ASTM C1396/C1396M.
1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Flexible Gypsum Board: ASTM C1396/C1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C1396/C1396M.
1. Thickness: 1/2 inch.

2. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
   1. Core: 5/8 inch, Type X.
   2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C1047.

   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:

      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      d. L-Bead: L-shaped; exposed long flange receives joint compound.
      e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      f. Expansion (control) joint.
      g. Curved-Edge Cornerbead: With notched or flexible flanges.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
   1. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
   2. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C475/C475M.

B. Joint Tape:

   1. Interior Gypsum Board: Paper.
   2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
   3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.

   1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
   2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.7 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION AND FINISHING OF PANELS, GENERAL

A. Comply with ASTM C840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. 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.

D. Locate edge and 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. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless 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 structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.
2. Type X: As indicated on Drawings.
3. Ceiling Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

    a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with

vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Curved Surfaces:

1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch-long straight sections at ends of curves and tangent to them.
2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

3.4 INSTALLATION OF TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLATION OF TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. L-Bead: Use where indicated.
3. U-Bead: Use at exposed panel edges.
4. Curved-Edge Cornerbead: Use at curved openings.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 3: Where indicated on Drawings.
4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

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.

END OF SECTION 092900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceramic mosaic tile.
2. Porcelain tile.
3. Glazed wall tile.
4. Stone thresholds.
5. Tile backing panels.
6. Crack isolation membrane.
7. Metal edge strips.

B. Related Requirements:
1. Section 079200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 092900 "Gypsum Board" for glass-mat, water-resistant backer board.

1.2 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications

C. Face Size: Actual tile size, excluding spacer lugs.

D. Module Size: Actual tile size plus joint width indicated.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Initial Selection: For tile, grout, and accessories involving color selection.

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
2. Full-size units of each type of trim and accessory for each color and finish required.
3. Stone thresholds in 6-inch lengths.
4. Metal edge strips in 6-inch lengths.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.

1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
2. Obtain crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

B. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Stone thresholds.
2. Crack isolation membrane.
3. Cementitious backer units.
4. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Ceramic Tile Type: porcelain tile.
1. See drawings
2. Face Size Variation: Rectified.
3. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable. Provide shapes selected from manufacturer's standard shapes:

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C503/C503M, with a minimum abrasion resistance of [**10**] [**12**] according to ASTM C1353 or ASTM C241/C241M and with honed finish.

1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 TILE BACKING PANELS

A. Cementitious Gypsum Backer Units: ASTM C1178, Type X, in maximum lengths available to minimize end-to-end butt joints.
1. Thickness: 5/8 inch.

2.6 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

C. Latex-Portland Cement Crack-Resistant Mortar: Flexible mortar consisting of cement-based mix and latex additive.

D. Crack Isolation Membrane and Tile-Setting Adhesive: One-part, fluid-applied product intended for use as both a crack isolation membrane and tile-setting adhesive in a two-step process.

2.7 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Asphalt felt, ASTM D226/D226M, Type I (No. 15); or polyethylene sheeting, ASTM D4397, 4.0 mils thick.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A185/A185M and ASTM A82/A82M, except for minimum wire size.

3. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Standard Dry-Set Mortar (Thinset): ANSI A118.1.
1. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

C. Modified Dry-Set Mortar (Thinset): ANSI A118.4.
1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

D. Improved Modified Dry-Set Mortar (Thinset): ANSI A118.15.
1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with [**acrylic resin**] [**or**] [**styrene-butadiene-rubber**] liquid-latex additive at Project site.

E. Organic Adhesive: ANSI A136.1, Type I.

2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

C. High-Performance Tile Grout: ANSI A118.7.
   1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

D. Water-Cleanable Epoxy Grout: ANSI A118.3, with a VOC content of 65 g/L or less.

E. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.9 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless steel, ASTM A276/A276M or ASTM A666, 300 Series exposed-edge material.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.10 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with adhesives or thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of 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.

3.3 INSTALLATION OF CERAMIC TILE

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

    a. Exterior tile floors.
    b. Tile floors in wet areas.
    c. Tile swimming pool decks.

d. Tile floors in laundries.
e. Tile floors consisting of tiles 8 by 8 inches or larger.
f. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Ceramic Mosaic Tile: 1/16 inch.
2. Glazed Wall Tile: 1/16 inch.
3. Porcelain Tile: 1/4 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

J. Metal Edge Strips: Install at locations indicated.

K. Floor Sealer: Apply floor sealer to grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 INSTALLATION OF TILE BACKING PANEL

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use modified dry-set mortar for bonding material unless otherwise directed in manufacturer's written instructions.

3.5 INSTALLATION OF CRACK ISOLATION MEMBRANE

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.6 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.7 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation: TCNA F113; thinset mortar.

a. Ceramic Tile Type: .
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance sanded or High-performance unsanded or Water-cleanable epoxy

B. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.

a. Ceramic Tile Type: .
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance sanded.

2. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.

a. Ceramic Tile Type: .
b. Thinset Mortar: Improved modified dry-set mortar.
c. Grout: High-performance sanded grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:

1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch-long Samples of each type, finish, and color.

C. Qualification Data: For testing agency.

D. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

E. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.
4. Impact Clips: Equal to 2 percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A according to ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS

A. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.

B. Classification: Provide panels as follows:
   1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with factory applied latex paint.
   2. Pattern: E (lightly textured).

C. Color: White.

D. Light Reflectance (LR): Not less than 0.85.

E. Ceiling Attenuation Class (CAC): Not less than 35.

F. Noise Reduction Coefficient (NRC): Not less than 0.85.

G. Articulation Class (AC): Not less than 170.

H. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.

I. Thickness: 7/8 inch minimum.

J. Modular Size: 24 by 24 inches.

K. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D3273, ASTM D3274, or ASTM G21 and evaluated according to ASTM D3274 or ASTM G21.

2.4 METAL SUSPENSION SYSTEM

A. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C635/C635M and designated by type, structural classification, and finish indicated.

B. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch-wide metal caps on flanges.

   1. Structural Classification: Intermediate-duty system.
   2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
   3. Face Design: Flat, flush.
   4. Cap Material: Cold-rolled steel or aluminum.
   5. Cap Finish: Painted white.

2.5 ACCESSORIES

A. Wire Hangers, Braces, and Ties: Provide wires as follows:

   1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.

2. Stainless-Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
3. Nickel-Copper-Alloy Wire: ASTM B164, nickel-copper-alloy UNS No. N04400.
4. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch-diameter wire.

B. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

C. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

E. Hold-Down Clips: Manufacturer's standard hold-down.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.

B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

A. Install acoustical panel ceilings according to ASTM C636/C636M and manufacturer's written instructions.

B. Suspend ceiling hangers from building's 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 structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.

D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
2. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
3. Install hold-down clips in vestibules and areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.

a. Hold-Down Clips: Space 24 inches o.c. on all cross runners.

3.4 ERECTION TOLERANCES

A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

B. Acoustical panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.6 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.

B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.
2. Rubber molding accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.

3. 48 hours after installation.

B. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

A. Product Standard: ASTM F1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).

1. Style and Location:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient floor coverings.
c. Style C, Butt to: Provide in areas indicated.

B. Thickness: 0.125 inch.

C. Height: 4 inches.

D. Lengths: Coils in manufacturer's standard length.

E. Outside Corners: Job formed or preformed.

F. Inside Corners: Job formed or preformed.

G. Colors: Match Architect's sample.

2.2 RUBBER MOLDING ACCESSORY

A. Description: Rubber carpet edge for glue-down applications, nosing for carpet, nosing for resilient floor covering, reducer strip for resilient floor covering, joiner for tile and carpet transition strips.

B. Profile and Dimensions: As indicated.

C. Locations: Provide rubber molding accessories in areas indicated.

D. Colors and Patterns: Match Architect's sample.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Metal Edge Strips: Extruded aluminum with mill finish, nominal 2 inches wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

D. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Form without producing discoloration (whitening) at bends.

2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

    a. Miter corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:

1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
2. Tightly adhere to substrates throughout length of each piece.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of resilient floor tile.

1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples: Full-size units of each color, texture, and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

D. Welded-Seam Samples: For seamless-installation technique indicated and for each floor covering product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.

E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Close spaces to traffic during floor tile installation.

C. Close spaces to traffic for 48 hours after floor tile installation.

D. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 SOLID VINYL FLOOR TILE Insert drawing designation

A. Tile Standard: ASTM F1700.

1. Class: Class I, Monolithic Vinyl Tile Class II, Surface-Decorated Vinyl Tile Class III, Printed Film Vinyl Tile.
2. Type: A, Smooth Surface.

B. Thickness: 0.120 inch.

C. Size: As indicated on drawings.

D. Colors and Patterns: Match Architect's samples.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

C. Floor Polish: Provide protective, liquid floor-polish products as recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH. To be verified with adhesive
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

5. Relative Humidity Test: Using in-situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 Insert number percent relative humidity level measurement. To be verified with adhesive

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor 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 that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply as recommended by manufacture coat(s).

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl wall covering.
2. Thermoplastic-polyolefin wall covering.
3. Wallpaper.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement seams and termination points.

C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches (914 mm) long in size.

D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same production run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

2.2 VINYL WALL COVERING

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. Maharam.

2. Or Approved equal

B. Description: Provide vinyl products in rolls from same production run and complying with the following:

1. FS CCC-W-408D and Wallcovering Association's W-101 for Type II, Medium Duty.

C. Total Weight: 20 oz, excluding coatings.

D. Width: 52 inches.

E. Backing: Nonwoven fabric.

1. Fiber Content: Polyester / cellulose.

F. Repeat: 22 ¼” V, 26” H.

G. Features:

1. Stain-Resistant Coating: .
2. Antimicrobial.
3. Water-based inks.
4. Phthalate free.
5. Heavy-metals free.
6. Halogenated-fire-retardant free.
7. Microvented.

H. Colors, Textures, and Patterns: Match Architect's samples.

2.3 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
2. Plaster: Allow plaster to cure for at least 90 days. Neutralize areas of high alkalinity. Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
3. Metals: If not factory primed, clean and apply metal primer as recommended in writing by metal-primer manufacturer and wall-covering manufacturer.

D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 INSTALLATION OF WALL COVERING

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cutting
1. Inspect wallcovering carefully prior to cutting and examine material for any damage or defects, as cut material cannot be returned. Be certain pattern and color are as ordered. Should you have any questions, contact manufacture.
2. Never use wallcovering from different production runs on one wall. Only full widths of material should be used for the most satisfactory installation..

C. Adhesive Application
1. Store and apply adhesive at room temperature (70F). Use a heavy-duty, clear, pre-mixed, wallcovering adhesive. Do not dilute. Apply an even coat of adhesive to the back side of material using a stiff bristle brush or roller, and exercise care not to over-saturate. Allow adhesive to become tacky before applying wallcovering.
2. When pasting several strips in advance, booking and rolling is recommended to ensure proper wetting of the fibers. All 100% Vinyl wallcovering textiles require a minimum of 12 minutes booking time prior to installation to allow for the absorption of adhesives and the expansion of the material. All other non-woven wallcovering textiles require a minimum of 20 minutes booking time. Do not crease when booking material, as damage will occur.
3. Care should be taken not to get adhesive on the face of the material. Any excessive adhesive must be removed immediately with a natural sponge and clean warm water and then dried with a white towel or soft cloth. Do not use solvent based cleansers as damage to the inks will occur..

D. Wall application
1. When received, wallcovering is untrimmed and must be double cut on the wall using a #0.12 single edge razor blade. Install material from top to bottom between two plumb

lines for absolute vertical alignment with minimal trim. Start at the top left corner with the first panel. Set top to hold while setting the corner edge. Wallcovering strips should be hung in consecutive order after cutting to avoid in-filling. Trim at least 2"-3" off each selvedge. If there is no design repeat (i.e. random texture), patterns should be reverse hung. Refer to label affixed to each roll for specific lot information.

2. Please note that System, one of manufactures' non-woven wallcovering patterns is a straight hang/match pattern and should only be trimmed approximately 1.5" to 2" from each selvedge when overlapping the seam to ensure proper alignment of the pattern.
3. Apply wallcovering at least 6" around outside corners. Do not stretch fabric. Do not overwork seams. Smooth the surface, work out air bubbles and remove excess paste immediately with clean warm water, a natural sponge, a soft bristle brush (if necessary), and clean towels. Subtle seaming is inherent to all wallcovering and
4. can be minimized by experienced installers. If seams are prominent, they should be worked into the architectural treatment.
5. After installation, the walls and wallcovering should be monitored for potential moisture or vapor infiltration. Any such infiltration after installation must be promptly eliminated.
6. Note that variations in the color of iridescent inks will occur when viewed from different angles and under changing light sources.
7. Shading tends to be optical and should be checked carefully prior to hanging. Visually matching each panel will reduce and control this condition.
8. Burnished, Honor Weave, Overlay, Splice and Whirlwind, are constructed of a non-woven fabric overlay of spun polyester fiber that causes intentional variation in color and texture. Clusters of fiber in the overlay occur at varying densities and orientations sporadically throughout the product and are inherent to the design.
9. If defects in the material are noticeable after hanging three lengths, you must notify your representative immediately. Maharam cannot accept any claims on labor or material after more than three lengths have been cut and installed. Install wall covering without lifted or curling edges and without visible shrinkage.

3.4 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Finish coatings.
3. Floor sealers and paints.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.
3. Section 099600 "High-Performance Coatings" for tilelike coatings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product Schedule: Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 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. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

B. Colors: Match Architect's samples.

2.3 PRIMERS

A. Exterior, Alkali-Resistant, Water-Based Primer: Pigmented, water-based primer formulated for use on alkaline surfaces, such as exterior plaster, vertical concrete, and masonry.

B. Exterior, Latex Wood Primer: White, waterborne-emulsion primer formulated for resistance to extractive bleeding, mold, and microbials; for hiding stains; and for use on exterior wood subject to extractive bleeding.

C. Exterior, Latex Block Filler: Water-based, pigmented, high-solids, emulsion coating formulated to bridge and fill porous surfaces of exterior concrete masonry units in preparation for specified subsequent coatings.
   1. Minimum Solids Content: Manufacturer's standard percentage solids by volume.

D. Water-Based Bonding Primer: Pigmented, water-based-emulsion primer formulated for exterior use and to promote adhesion of subsequent specified coatings.

E. Solvent-Based Bonding Primer: Pigmented, solvent-based primer formulated for exterior use and to seal substrates and promote adhesion of specified subsequent coatings.

F. Water-Based, Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, exterior ferrous metals subject to mildly corrosive environments.

G. Zinc-Rich, Inorganic Primer: Corrosion-resistant, inorganic-based, zinc-rich primer formulated for use on prepared steel subject to severe industrial or marine environments.

H. Surface-Tolerant Metal Primer: Corrosion-resistant, solvent-based metal primer formulated for use on structural steel and metal fabrications that have been minimally prepared.

I. Quick-Drying, Alkyd Metal Primer: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, exterior steel surfaces.

J. Alkyd Metal Primer: Corrosion-resistant, solvent-based, alkyd primer formulated for use on prepared ferrous metals subject to industrial and light marine environments.

K. Water-Based, Galvanized-Metal Primer: Corrosion-resistant, pigmented, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.

L. Epoxy Metal Primer: Corrosion-resistant, solvent-based, two-component epoxy primer formulated for use on prepared, exterior ferrous- and galvanized-metal surfaces.

M. Vinyl Wash Primer: Two-component, vinyl butyral/phosphoric acid, wash primer formulated for use over cleaned metal surfaces and zinc-rich primers as a tie coat for subsequent corrosion-resistant primers or finish coatings.

2.4 FINISH COATINGS

A. Exterior Alkyd Enamel, Semigloss: Solvent-based, pigmented, alkyd enamel formulated for mold, microbial, and water resistance and for use on exterior, primed, wood and metal surfaces.
   1. Gloss Level: Manufacturer's standard semigloss finish.

B. Exterior Alkyd Enamel, Gloss: Solvent-based, pigmented, alkyd enamel formulated for mold, microbial, and water resistance and for use on exterior, primed, wood and metal surfaces.
   1. Gloss Level: Manufacturer's standard gloss finish.

C. Exterior, Water-Based, Light Industrial Coating, Semigloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
   1. Gloss Level: Manufacturer's standard semigloss finish.

D. Exterior, Water-Based, Light Industrial Coating, Gloss: Corrosion-resistant, water-based, pigmented, emulsion coating formulated for resistance to blocking (sticking of two painted surfaces), water, alkalis, moderate abrasion, and mild chemical exposure and for use on exterior, primed, wood and metal surfaces.
   1. Gloss Level: Manufacturer's standard gloss finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

   1. Concrete: 12 percent.
   2. Fiber-Cement Board: 12 percent.
   3. Masonry (Clay and Concrete Masonry Units): 12 percent.
   4. Wood: 15 percent.
   5. Portland Cement Plaster: 12 percent.
   6. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Exterior Gypsum Board Substrates: Verify that finishing compound is dry and sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

1. SSPC-SP 2.
2. SSPC-SP 3.
3. SSPC-SP 7/NACE No. 4.
4. SSPC-SP 11.

F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Masonry Unit Substrates:

1. Water-Based, Light Industrial Coating System:

a. Prime Coat: Exterior, latex block filler.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based, light industrial coating, semigloss.

B. Steel and Iron Substrates:

1. Water-Based, Light Industrial Coating System:

a. Prime Coat: Alkyd metal primer or Shop primer specified in Section in which substrate is specified.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based, light industrial coating, semigloss and gloss; verify with architect.

2. Alkyd System:

a. Prime Coat: Alkyd metal primer or Shop primer specified in Section in which substrate is specified.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior alkyd enamel, semigloss and gloss; verify with architect.

C. Galvanized-Metal Substrates:

1. Water-Based, Light Industrial Coating System:

a. Prime Coat: Epoxy metal primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Exterior, water-based, light industrial coating, semigloss and gloss; verify with architect.

.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.
3. Solvent-based finish coatings.
4. Floor sealers and paints.

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for shop priming structural steel.
2. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 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. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Benjamin Moore & Co.
2. PPG Paints.
3. Sherwin-Williams Company (The).

B. Source Limitations: Obtain each paint product from single source from single manufacturer.

2.2 PAINT PRODUCTS, GENERAL

A. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

B. Colors: As indicated in a color schedule.

2.3 PRIMERS

A. Interior/Exterior Latex Block Filler: Water-based, high-solids, emulsion coating formulated to bridge and fill porous surfaces of exterior concrete masonry units in preparation for specified subsequent coatings.

B. Alkali-Resistant, Water-Based Primer: Water-based primer formulated for use on alkaline surfaces, such as plaster, vertical concrete, and masonry.

C. Interior Latex Primer Sealer: Water-based latex sealer used on new interior plaster, concrete, and gypsum wallboard surfaces.

D. Interior, Institutional Low-Odor/VOC Primer Sealer: Water-based primer sealer with low-odor characteristics and a VOC of less than 10 grams per liter for use on new interior plaster, concrete, and gypsum wallboard surfaces that are subsequently to be painted with latex finish coats.

E. Interior Alkyd Primer Sealer: Solvent-based, alkyd-type, primer/sealer for new interior wood, plaster, and porous surfaces,

F. Water-Based Rust-Inhibitive Primer: Corrosion-resistant, water-based-emulsion primer formulated for resistance to flash rusting when applied to cleaned, interior ferrous metals subject to mildly corrosive environments.

G. Alkyd Quick-Dry Primer for Metal: Corrosion-resistant, solvent-based, modified-alkyd primer; lead and chromate free; formulated for quick-drying capabilities and for use on cleaned, interior steel surfaces.

H. Anti-Corrosive Epoxy Primer: Corrosion-resistant, solvent-based, two-component epoxy primer formulated for use on prepared, interior ferrous- and galvanized-metal surfaces.

I. Surface-Tolerant Metal Primer: Corrosion-resistant, solvent-based metal primer formulated for use on structural steel and metal fabrications that have been minimally prepared.

J. Cementitious Galvanized Primer: Solvent-based primer composed of linseed oil/alkyd resin and portland cement for cleaned galvanized metal prior to finish coating.

K. Water-Based Galvanized-Metal Primer: Corrosion-resistant, acrylic primer; formulated for use on cleaned/etched, exterior, galvanized metal to prepare it for subsequent water-based coatings.

L. Water-Based Bonding Primer: Water-based-emulsion primer formulated to promote adhesion of subsequent specified coatings.

M. Solvent-Based Bonding Primer: Solvent-based primer formulated to seal substrates and promote adhesion of specified subsequent coatings.

2.4 WATER-BASED FINISH COATS

A. Interior, Latex, Institutional Low Odor/VOC, Flat: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
   1. Gloss and Sheen Level: Manufacturer's standard flat finish.

B. Interior, Latex, Institutional Low Odor/VOC, Eggshell: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
   1. Gloss and Sheen Level: Manufacturer's standard eggshell finish.

C. Interior, Latex, Institutional Low Odor/VOC, Semigloss: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
   1. Gloss Level: Manufacturer's standard semigloss finish.

D. Interior, Latex, Institutional Low-Odor/VOC, Gloss: White or colored latex paint with low-odor characteristics and a VOC of less than 10 grams per liter, for use in areas, such as hospitals and other occupied buildings, where the odor and VOC levels of conventional latex products would preclude their use.
   1. Gloss Level: Manufacturer's standard gloss finish.

E. Interior, Water-Based Light-Industrial Coating, Eggshell: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.
   1. Gloss and Sheen Level: Manufacturer's standard eggshell finish.

F. Interior, Water-Based Light-Industrial Coating, Semigloss: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.
   1. Gloss Level: Manufacturer's standard semigloss finish.

G. Interior, Water-Based Light-Industrial Coating, Gloss: Pigmented, water-based emulsion coating for interior primed wood and metal surfaces (e.g., walls, doors, frames, trim, and sash), providing resistance to moderate abrasion and mild chemical exposure and corrosive conditions.

1. Gloss Level: Manufacturer's standard gloss finish.

2.5 SOLVENT-BASED FINISH COATS

A. Interior, Alkyd, Flat: Pigmented, solvent-based alkyd paint for use on primed/sealed interior plaster, gypsum, wood, and metal walls primarily in residential and moderate traffic commercial environments.
   1. Gloss and Sheen Level: Manufacturer's standard flat finish.

B. Interior, Alkyd, Eggshell: Pigmented, solvent-based alkyd paint for use on primed/sealed interior plaster, gypsum, wood, and metal walls primarily in residential and moderate traffic commercial environments.
   1. Gloss and Sheen Level: Manufacturer's standard eggshell finish.

C. Interior, Alkyd, Semigloss: Pigmented, solvent-based alkyd paint for use on primed/sealed interior plaster, gypsum, wood, and metal walls primarily in residential and moderate traffic commercial environments.
   1. Gloss Level: Manufacturer's standard semigloss finish.

D. Interior, Alkyd, Gloss: Pigmented, solvent-based alkyd paint for use on primed/sealed interior plaster, gypsum, wood, and metal walls primarily in residential and moderate traffic commercial environments.
   1. Gloss Level: Manufacturer's standard gloss finish.

2.6 FLOOR SEALERS AND PAINTS

A. Water-Based Concrete Floor Sealer: Clear, water-based, acrylic-copolymer-emulsion sealer formulated for oil, gasoline, alkali, and water resistance and for use on concrete traffic surfaces.

B. Solvent-Based Concrete Floor Sealer: Clear, acrylic, solvent-based sealer formulated for oil, gasoline, alkali, and water resistance and for use on concrete traffic surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

   1. Concrete: 12 percent.
   2. Masonry (Clay and CMUs): 12 percent.
   3. Wood: 15 percent.
   4. Gypsum Board: 12 percent.

5. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Traffic Surfaces:

1. Water-Based Concrete Floor Sealer System:

   a. First Coat: Matching topcoat.
   b. Topcoat: Water-based concrete floor sealer.

2. Solvent-Based Concrete Floor Sealer System:

   a. First Coat: Matching topcoat.
   b. Topcoat: Solvent-based concrete floor sealer.

B. CMU Substrates:

1. Institutional Low-Odor/VOC Latex System:

   a. Block Filler: Interior/exterior latex block filler.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Interior, latex, institutional low odor/VOC, eggshell.

2. Water-Based Light-Industrial Coating System:

   a. Block Filler: Interior/exterior latex block filler.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Interior, water-based, light-industrial coating, semigloss.

C. Steel Substrates:

1. Water-Based Light-Industrial Coating System:

   a. Prime Coat: Primer, rust-inhibitive, water based.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Interior, water-based, light-industrial coating, semigloss, gloss.

2. Water-Based Light-Industrial Coating System over Epoxy Primer System:

   a. Prime Coat: Anticorrosive epoxy primer.
   b. Intermediate Coat: Matching topcoat.
   c. Topcoat: Interior, water-based, light-industrial coating, semigloss, gloss.

3. Water-Based Dry-Fall System:

   a. Prime Coat: Alkyd quick-dry primer for metal Shop primer specified in Section where substrate is specified.
   b. Topcoat: Dry fall, latex, flat Water-based dry fall for galvanized steel, flat.

4. Alkyd System:

a. Prime Coat: Alkyd quick-dry primer for metal or Shop primer specified in Section where substrate is specified.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, alkyd, semigloss, gloss.

5. Alkyd Dry-Fall System:

a. Prime Coat: Shop primer specified in Section where substrate is specified.
b. Topcoat: Alkyd, dry fall, flat.

6. Alkyd Dry Fall over Quick-Drying Primer System:

a. Prime Coat: Quick-dry primer for shop application.
b. Topcoat: Alkyd, dry fall, flat.

D. Galvanized-Metal Substrates:

1. Institutional Low-Odor/VOC Latex System Insert drawing designation:

a. Prime Coat: Water-based galvanized primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, institutional low odor/VOC, semigloss, gloss.

2. Water-Based Light-Industrial Coating System:

a. Prime Coat: Cementitious galvanized primer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, water-based, light-industrial coating, semigloss, gloss.

3. Water-Based Dry-Fall System:

a. Prime Coat: Matching topcoat.
b. Topcoat: Water-based dry fall for galvanized steel, flat.

E. Gypsum Board Substrates:

1. Latex over Latex Sealer System Insert drawing designation:

a. Prime Coat: Interior latex primer sealer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, flat, eggshell, semigloss, gloss.

2. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, institutional low odor/VOC, flat, eggshell, semigloss.

3. High-Performance Architectural Latex System:

a. Prime Coat: Interior latex primer sealer.
b. Intermediate Coat: Matching topcoat.
c. Topcoat: Interior, latex, high-performance architectural coating, semigloss.

END OF SECTION 099123

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes room-identification signs that are directly attached to the building.

1.2 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.3 COORDINATION

A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.

B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For room-identification signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

4. Include representative Samples of available typestyles and graphic symbols.

C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Room-Identification Signs: Full-size Sample.
2. Full-size Samples, if approved, will be returned to Contractor for use in Project.

D. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer of products.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify locations of anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Deterioration of finishes beyond normal weathering.
b. Deterioration of embedded graphic image.
c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

A. Room-Identification Sign: Sign system with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

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. ASI Sign Systems, Inc.

2. Sign-Panel Perimeter: Finish edges smooth.

    a. Edge Condition at Horizontal Edges: Square cut.
    b. Corner Condition in Elevation: Rounded to radius indicated.

3. Frame: Entire perimeter to hold changeable sign panel.

    a. Material: Aluminum.
    b. Frame Depth: Frame to receive removable face sheet and changeable subsurface graphics.
    c. Profile: Rounded.
    d. Corner Condition in Elevation: Rounded to radius indicated.
    e. Finish and Color: Clear anodized.

4. Mounting: Surface mounted to wall with concealed anchors.
5. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

D. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:

    a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
    b. Fastener Heads: Use oval countersunk screws and bolts with tamper-resistant Allen-head, spanner-head or one-way-head slots unless otherwise indicated.

4. Sign Mounting Fasteners:

    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
    b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.

B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:

1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. Subsequent changeable inserts are by Owner .
2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. Subsequent changeable inserts are by Owner.
3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. Subsequent changeable sign panels are by Owner.

2.6 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Accessibility: Install signs in locations on walls as indicated on Drawings and according to the accessibility standard.

C. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.2 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.3 SCHEDULE

A. Sign Type A: 8” x 8” Pictorial with with Raised symbol and contrasting colors to comply with ADA & TDLR guidelines.
1. Toilet Rooms
2. Locker Rooms
3. Wellness Rooms

B. Sign Type B: 6” x 8” Raised symbol and contrasting colors to comply with ADA & TDLR guidelines.
1. Electrical Rooms
2. Mechanical Rooms
3. Break Room

C. Sign Type C1: 6” x 8” Room name sign with an Interchangeable room identification area and a protective cover for room name.
   1. All office

D. Sign Type C2: 6” x 8” Room name sign with an Interchangeable room identification area and a protective cover for room name. Where applied to glass sign shall be supplied with a room side backing plate
   1. Rooms where sign is applied to glass

END OF SECTION 101423.16

SECTION 102113.19 - PLASTIC TOILET COMPARTMENTS

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. Solid-plastic toilet compartments configured as toilet enclosures and urinal screens.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for supports that attach floor-and-ceiling-anchored compartments to overhead structural system.
2. Section 061053 "Miscellaneous Rough Carpentry" for blocking overhead support of floor-and-ceiling-anchored compartments.
3. Section 092216 "Non-Structural Metal Framing" for blocking.
4. Section 102800 "Toilet, Bath, and Laundry Accessories" for accessories mounted on toilet compartments.

1.3 COORDINATION

A. Coordinate requirements for overhead supports, blocking, reinforcing, and other supports concealed within wall and ceiling.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Solid-plastic toilet compartments:

a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for toilet compartments.

B. Shop Drawings: For solid-plastic toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.

4. Show locations of floor drains.
5. Show ceiling grid, ceiling-mounted items, and overhead support or bracing locations.

C. Samples for Verification: Actual sample of finished products for each type of toilet compartment indicated.

1. Size: Manufacturers standard size.
2. Include each type of hardware and accessory.

D. Product Schedule: For toilet compartments, prepared by or under the supervision of supplier, detailing location and selected colors for toilet compartment material.

E. Sustainable Design Submittals:

1. 100% Recycled material

1.5 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Product Certificates: For each type of toilet compartment by manufacturer.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Door Hinges: One hinge(s) with associated fasteners.
2. Latch and Keeper: One latch(es) and keeper(s) with associated fasteners.
3. Door Bumper: One bumper(s) with associated fasteners.
4. Door Pull: One door pull(s) with associated fasteners.
5. Fasteners: 10 fasteners of each size and type.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements, and coordinate before fabrication.

1.9 WARRANTY

A. 20 YEARS

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire Performance: Tested in accordance with, and pass the acceptance criteria of, NFPA 286.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Department of Justice "2010 ADA Standards for Accessible Design" and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

A. Toilet-Enclosure Style: Floor and ceiling anchored.

B. Urinal-Screen Style: Wall hung.

C. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, no-sightline system, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, stainless steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
3. Color and Pattern: One color and pattern in each room as selected by Architect from manufacturer's full range.

D. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

E. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters; with shoe and sleeve (cap) matching that on the pilaster.

F. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, stainless steel.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories, Heavy Duty: Manufacturer's heavy-duty operating hardware and accessories.

1. Hinges: Manufacturer's minimum 0.062-inch-thick stainless steel paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door. Mount with through bolts.
2. Latch and Keeper: Manufacturer's heavy-duty, surface-mounted, cast-stainless steel latch unit, designed to resist damage due to slamming, with combination rubber-faced door strike and keeper, and with provision for emergency access. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Mount with through bolts.
3. Coat Hook: Manufacturer's heavy-duty combination cast-stainless steel hook and rubber-tipped bumper, sized to prevent inswinging door from hitting compartment-mounted accessories. Mount with through bolts.
4. Door Bumper: Manufacturer's heavy-duty, rubber-tipped, cast-stainless steel bumper at outswinging doors. Mount with through bolts.
5. Door Pull: Manufacturer's heavy-duty, cast-stainless steel pull at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through bolts.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304, stretcher-leveled standard of flatness.

B. Stainless Steel Castings: ASTM A743/A743M.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

C. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves (caps) at posts to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, inswinging doors for standard toilet compartments and 36-inch-wide, outswinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PLASTIC TOILET COMPARTMENTS

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch.
b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets, so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

B. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust, so doors are level and aligned with panels, when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on inswinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on outswinging doors to return doors to fully closed position.

END OF SECTION 102113.19

SECTION 102600 - WALL AND DOOR PROTECTION

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. Corner guards.
   2. End-wall guards.
   3. Abuse-resistant wall coverings.

B. Related Requirements:

   1. Section 055000 "Metal Fabrications" for steel angle corner guards pipe guards and wheel guards.
   2. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
   2. Include fire ratings of units recessed in fire-rated walls and listings for door-protection items attached to fire-rated doors.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:

   1. Wall Guards: 12 inches long. Include examples of joinery, corners, end caps, and field splices.
   2. Corner and End-Wall Guards: 12 inches long. Include example top caps.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type of exposed plastic material.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

a. Store corner-guard covers in a vertical position.
b. Store wall-guard covers in a horizontal position.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 CORNER GUARDS

A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.
1. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; as follows:

a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.
b. Height: 4 feet (1.2 m).
c. Color and Texture: Match Architect's sample.

2. Continuous Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
3. Retainer Clips: Manufacturer's standard impact-absorbing clips.
4. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

B. Surface-Mounted, Metal Corner Guards: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
1. Material: Stainless-steel sheet, Type 304.

a. Thickness: Minimum 0.0500 inch.
b. Finish: Directional satin, No. 4.

2. Wing Size: Nominal 2-1/2 by 2-1/2 inches.
3. Corner Radius: 1/8 inch.
4. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

2.4 END-WALL GUARDS

A. Surface-Mounted, Plastic-Cover, End-Wall Guard: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover installed over continuous retainer; including mounting hardware.
   1. Cover: Extruded rigid plastic, minimum 0.078-inch (2.0-mm) wall thickness; as follows:
      a. Profile: Nominal 2-inch- (50-mm-) long leg and 1/4-inch (6-mm) corner radius.
      b. Height: 4 feet (1.2 m).
      c. Color and Texture: Match Architect's sample Match corner guards.
   2. Retainer: Minimum 0.060-inch- (1.5-mm-) thick, one-piece, extruded aluminum.
   3. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.5 ABUSE-RESISTANT WALL COVERINGS

A. Abuse-Resistant Sheet Wall Covering: Fabricated from semirigid, plastic sheet wall-covering material.
   1. Size: 48 by 96 inches (1219 by 2438 mm) for sheet.
   2. Sheet Thickness: 0.060 inch (1.5 mm).
   3. Color and Texture: Match Architect's sample.
   4. Height: Wainscot.
   5. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
   6. Mounting: Adhesive.

2.6 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D256, Test Method A.

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Adhesive: As recommended by protection product manufacturer.

2.7 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.8 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Underlavatory guards.
4. Custodial accessories.

B. Related Requirements:

1. Section 088300 "Mirrors" for frameless mirrors.
2. Section 093013 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.2 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Include electrical characteristics.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify accessories using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For accessories to include in maintenance manuals.

1.6 WARRANTY

A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, visible silver spoilage defects.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Structural Performance: Design accessories and fasteners to comply with the following requirements:

1. Grab Bars: Installed units are able to resist 250 lbf concentrated load applied in any direction and at any point.
2. Shower Seats: Installed units are able to resist 360 lbf applied in any direction and at any point.

2.2 WASHROOM ACCESSORIES

A. Toilet Tissue (Roll) Dispenser :

1. Description: Double-roll dispenser with shelf.
2. Mounting: Surface mounted.
3. Operation: Noncontrol delivery with standard spindle.
4. Capacity: Designed for 4-1/2- or 5-inch-diameter tissue rolls.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Recessed Convertible Paper Towel Dispenser/Waste Receptacle:

1. Description: Combination unit for dispensing preset length of roll paper towels, with removable waste receptacle.

2. Towel Mechanism: Pull towel..
3. Mounting: Recessed.
4. Minimum Towel-Dispenser Capacity: 8-inch-wide, 800-foot-long roll.
5. Minimum Waste Receptacle Capacity: 15 gal..
6. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
7. Liner: Reusable, vinyl waste-receptacle liner.
8. Lockset: Tumbler type for towel dispenser compartment and waste receptacle.

C. Grab Bar:

1. Mounting: Flanges with exposed fasteners.
2. Material: Stainless steel, 0.05 inch thick.

    a. Finish: Smooth, ASTM A480/A480M No. 4 finish (satin) on ends and slip-resistant texture in grip area.

3. Outside Diameter: 1-1/4 inches.
4. Configuration and Length: As indicated on Drawings.

D. Sanitary-Napkin Disposal Unit :

1. Mounting: Surface mounted.
2. Door or Cover: Self-closing, disposal-opening cover.
3. Receptacle: Removable.
4. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

E. Seat-Cover Dispenser:

1. Mounting: Surface mounted.
2. Minimum Capacity: 250 seat covers.
3. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
4. Lockset: Tumbler type.

F. Mirror Unit :

1. Frame: Stainless steel angle, 0.05 inch thick.

    a. Corners: Manufacturer's standard.

2. Size: As indicated on Drawings.

3. Hangers: Manufacturer's standard rigid, tamper and theft resistant.

G. Hook:

1. Description: Combination hat and coat hook.
2. Mounting: Concealed.
3. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.3 PUBLIC-USE SHOWER ROOM ACCESSORIES

A. Shower Curtain:

1. Size: Minimum 12 inches wider than opening by 72 inches high.
2. Material: Vinyl, minimum 0.006 inch thick, opaque, matte.
3. Color: White.
4. Grommets: Corrosion resistant at minimum 6 inches o.c. through top hem.
5. Shower Curtain Hooks: Chrome-plated or stainless steel, spring wire curtain hooks with snap fasteners, sized to accommodate specified curtain rod. Provide one hook per curtain grommet.

B. Soap Dish:

1. Description: Recessed mounted, with the following features:

   a. Washcloth bar.

2. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

C. Robe Hook:

1. Description: Double-prong unit.
2. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

2.4 UNDERLAVATORY GUARDS

A. Underlavatory Guard:

1. Description: Insulating pipe covering for supply and drain piping assemblies that prevents direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.

2.5 CUSTODIAL ACCESSORIES

A. Custodial Utility Shelf:

1. Description: With exposed edges turned down not less than 1/2 inch and supported by two triangular brackets welded to shelf underside.
2. Size: 16 inches long by 6 inches deep.
3. Material and Finish: Not less than nominal 0.05-inch-thick stainless steel, ASTM A480/A480M No. 4 finish (satin).

B. Custodial Mop and Broom Holder:

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches.

3. Hooks: Four.
4. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).

    a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
    b. Rod: Approximately 1/4-inch-diameter stainless steel.

2.6 MATERIALS

A. Stainless Steel: ASTM A240/A240M or ASTM A666, Type 304, 0.031-inch-minimum nominal thickness unless otherwise indicated.

B. Steel Sheet: ASTM A1008/A1008M, Designation CS (cold rolled, commercial steel), 0.036-inch-minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A653/A653M, with G60 hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, unless otherwise recommended by manufacturer or specified in this Section, and tamper and theft resistant where exposed, and of stainless or galvanized steel where concealed.

F. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

1. Remove temporary labels and protective coatings.

B. Grab Bars: Install to comply with specified structural-performance requirements.

C. Shower Seats: Install to comply with specified structural-performance requirements.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 102800

SECTION 104413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:

a. Portable fire extinguisher.

B. Related Requirements:

1. Section 104416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.

B. Shop Drawings: For fire-protection cabinets.

1. Include plans, elevations, sections, details, and attachments to other work.

C. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E814 for fire-resistance rating of walls where they are installed.

2.3 FIRE-PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.

B. Cabinet Construction: Nonrated, One-hour fire rated, Two-hour fire rated.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.

C. Cabinet Material: Cold-rolled steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Recessed Cabinet:
1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

E. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

F. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.

G. Cabinet Trim Material: Same material and finish as door.

H. Door Material: Steel sheet.

I. Door Style: Center glass panel with frame.

J. Door Glazing: Tempered float glass (clear).

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide projecting door pull and friction latch.
2. Provide manufacturer's standard hinge, permitting door to open 180 degrees.

L. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated.

    a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

        1) Location: Applied to cabinet door.
        2) Application Process: Pressure-sensitive vinyl letters.
        3) Lettering Color: Black.
        4) Orientation: Vertical.

M. Materials:

1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.

    a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
    b. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    c. Color: As selected by Architect from manufacturer's full range.
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
   1. Fabricate door frames of one-piece construction with edges flanged.
   2. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

   1. Fire-Protection Cabinets: 42 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
   1. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:
   1. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 104413

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 104413 "Fire Protection Cabinets."

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. by NFPA 10 is within the warranty period.
    b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.
1. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
2. Valves: Manufacturer's standard.
3. Handles and Levers: Manufacturer's standard.
4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type: UL-rated nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

C. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.
1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

    a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: Top of fire extinguisher to be at 42 inches above finished floor.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 104416

SECTION 105113 - METAL LOCKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Welded corridor lockers.
   2. Locker benches.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker and bench.

B. Shop Drawings: For metal lockers.

   1. Include plans, elevations, sections, and attachment details.
   2. Show locker trim and accessories.
   3. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available.

D. Product Schedule: For lockers.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

B. Deliver master and control keys and combination control charts to Owner by registered mail or overnight package service.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Welded Metal Lockers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers, locker benches, and accessories from single source from single locker manufacturer.

1. Obtain locks from single lock manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers and locker benches indicated to be accessible, comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.3 WELDED CORRIDOR LOCKERS

A. Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
2. Door Style: Vented panel as follows:

a. Louvered Vents: No fewer than three louver openings at top and bottom for double-tier lockers.

B. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Sides: 0.060-inch nominal thickness.
2. Backs: 0.048-inch nominal thickness.
3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.

C. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

D. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.
1. Continuous Hinges: Manufacturer's standard, steel, full height.
2. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

E. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Single-Point Latching: Nonmoving latch hook designed to engage bolt of built-in combination or cylinder lock.

a. Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

F. Locks: Built-in combination locks.

G. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

H. Hooks: Manufacturer's standard ball-pointed, aluminum or steel; zinc plated.

I. Continuous Sloping Tops: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 20 degrees.

1. Closures: Vertical-end type.

J. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

K. Boxed End Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

L. Finished End Panels: Fabricated from 0.024-inch nominal-thickness steel sheet to cover unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

M. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

N. Finish: Baked enamel or powder coat.

1. Color: As selected by Architect from manufacturer's full range.

2.4 LOCKS

A. Built-in Combination Lock: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.

1. Bolt Operation: Manually locking deadbolt or automatically locking spring bolt.

2.5 LOCKER BENCHES

A. Provide bench units with overall assembly height of 17-1/2 inches.

B. Bench Tops: Manufacturer's standard one-piece units, with rounded corners and edges.

1. Size: Minimum 20- to 24-inch-wide tops where accessible benches are indicated.
2. Laminated clear hardwood with one coat of clear sealer on all surfaces and one coat of clear lacquer on top and sides.

C. Fixed-Bench Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel:

a. 1-1/2-inch-diameter steel tubing threaded on both ends, with standard pipe flange at top and bell-shaped cast-iron base; with baked-enamel or powder-coat finish; anchored with exposed fasteners.

1) Color: Match metal lockers.

D. Materials:
1. Steel Tube: ASTM A500/A500M, cold rolled.

2.6 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:
1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds smooth and flush.

E. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

H. Boxed End Panels: Fabricated with 1-inch-wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

I. Finished End Panels: Fabricated to conceal unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

J. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.

2.7 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top and bottom of lockers on top of concrete base.

B. Welded Lockers: Connect groups together with manufacturer's standard fasteners, with no exposed fasteners on face frames.

C. Equipment:

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.

a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.
4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.

E. Fixed Benches: Provide no fewer than two pedestals for each bench, uniformly spaced not more than 72 inches apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

F. Movable Benches: Place benches in locations indicated on Drawings.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral locking devices operate properly.

3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 105113

SECTION 107516 - GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes ground-set flagpoles made from aluminum.

B. Owner-Furnished Material: Flags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Shop Drawings: For flagpoles.

1. Include plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
2. Include section, and details of foundation system.

C. Delegated-Design Submittal: For flagpoles.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.

B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.

1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location 105mph
2. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole or flag size indicated, whichever is more stringent.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.

B. Exposed Height: 30 feet.

C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:

1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.

D. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.

1. Flashing Collar: Same material and finish as flagpole.

2.4 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

1. 0.063-inch spun aluminum with gold anodic finish.

B. External Halyard: Ball-bearing, nonfouling, revolving truck assembly of cast metal with continuous 5/16-inch-diameter, braided polypropylene halyard and 9-inch cast-metal cleats with fasteners. Finish exposed metal surfaces to match flagpole.

1. Halyards and Cleats: One at each flagpole.
2. Cleat Covers: Cast metal, finished to match flagpole, secured with cylinder locks.
3. Halyard Covers: 2-inch channel, 60 inches long, finished to match flagpole.
4. Halyard Flag Snaps: Stainless-steel swivel snap hooks. Furnish two per halyard.

2.5 MISCELLANEOUS MATERIALS

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M.

B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C33/C33M, fine aggregate.

D. Elastomeric Joint Sealant: Multicomponent nonsag urethane joint sealant complying with requirements in Section 079200 "Joint Sealants."

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

B. Gold Anodic Finish: AAMA 611, AA-M32C22A43; gold color.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

D. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

E. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.

F. Anchor Bolts: Locate and secure anchor bolts in forms with templates and by tying to reinforcement.

G. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

H. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

END OF SECTION 107516

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.

B. Related Requirements:

1. Section 061053 "Miscellaneous Rough Carpentry" for wood blocking and grounds for mounting roller shades and accessories.
2. Section 079200 "Joint Sealants" for sealing the perimeters of installation accessories for light-blocking shades with a sealant.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

D. Product Schedule: For roller shades.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of shadeband material.

C. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 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. Roller Shades: Full-size units equal to 5 percent of quantity installed for each size, color, and shadeband material indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Nickel-plated metal.

a. Loop Length: As indicated on Drawings.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

E. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.

3. Endcap Covers: To cover exposed endcaps.

4. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of site-constructed ceiling recess or pocket and for snap-in attachment to wall clip without fasteners.

5. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
6. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
7. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller shade manufacturer.
2. Type: 100% Thermoplastic Olefin .
3. Weave: Basketweave.
4. Thickness: 0.033in
5. Weight: 13.55 oz/yd2.
6. Roll Width: 98 inches.
7. Orientation on Shadeband: Up the bolt.
8. Openness Factor: 3 percent.
9. Color: As indicated on Drawings.
10. Features: Washable.

2.4 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances,and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

B. Roller Shade Locations: At exterior windows as indicated on Drawings.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.
4. Quartz agglomerate apron fronts.

B. Related Requirements:

1. Section 224100 "Residential Plumbing Fixtures" for sinks and plumbing fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
   1. Colors and Patterns: As selected by Architect from manufacturer's full range.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

   1. Grade: Premium.

B. Configuration:

   1. Front: Straight, slightly eased at top 1-1/2-inch laminated bullnose.
   2. Backsplash: Straight, slightly eased at corner.
   3. End Splash: Matching backsplash.

C. Countertops: 1/2-inch-thick, quartz agglomerate with front edge built up with same material.

D. Backsplashes: 1/2-inch-thick, quartz agglomerate.

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints: Fabricate countertops without joints.

G. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.

1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
2. Joint Type: Bonded, 1/32 inch or less in width.

H. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.

2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
4. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

F. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.19

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Resilient-tile entrance mats.
   2. Surface-mounted frames.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

B. Shop Drawings:

   1. Items penetrating floor mats and frames, including door control devices.
   2. Divisions between mat sections.
   3. Perimeter floor moldings and frames.
   4. Custom Graphics: Scale drawing indicating colors.

C. Samples: For the following products, in manufacturer's standard sizes:

   1. Floor Mat: Assembled sections of floor mat.
   2. Tread Rail: Sample of each type and color.
   3. Frame Members: Sample of each type and color.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.4 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. Resilient-Tile Entrance Mats: Full-size tile units equal to 2 percent of amount installed, but no fewer than 10 units.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Structural Performance: Provide roll-up rail mats and frames capable of withstanding the following loads and stresses within limits and under conditions indicated:

1. Uniform floor load of 300 lbf/sq. ft..
2. Wheel load of 350 lb per wheel.

B. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 RESILIENT-TILE ENTRANCE MATS

A. Carpet-Type Tiles: Nylon carpet bonded to 1/8- to 1/4-inch-thick, flexible vinyl backing to form mats 3/8 or 7/16 inch thick with nonraveling edges.

1. Colors, Textures, and Patterns: Match Architect's sample.
2. Tile Size: 24 x 24.

2.3 FRAMES

A. Surface-Mounted Frames:

1. Tapered Frames: Tapered aluminum frame members, not less than 2 inches wide, attached to mat at all four edges, with welded mitered corners.
   a. Aluminum Color: Clear.

2.4 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.5 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Surface-Mounted Frames: As indicated for permanent surface-mounted installation, complete with corner connectors, splice plates or connecting pins, and postinstalled expansion anchors.

C. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

2.6 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes,and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.

1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

SECTION 133419 - METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural-steel framing.
2. Metal roof panels.
3. Metal wall panels.
4. Accessories.

B. Related Requirements:

1. Section 033000 "Cast in Place Concrete" spread footings.

1.2 DEFINITIONS

A. Terminology Standard: See MBMA's "Metal Building Systems Manual" for definitions of terms for metal building system construction not otherwise defined in this Section or in standards referenced by this Section.

1.3 COORDINATION

A. Coordinate sizes and locations of concrete foundations and casting of anchor-rod inserts into foundation walls and footings. Anchor rod installation, concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate metal panel assemblies with rain drainage work, flashing, trim, and construction of supports and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to metal building systems including, but not limited to, the following:

a. Condition of foundations and other preparatory work performed by other trades.
b. Structural load limitations.
c. Construction schedule. Verify availability of materials and erector's personnel, equipment, and facilities needed to make progress and avoid delays.
d. Required tests, inspections, and certifications.

e. Unfavorable weather and forecasted weather conditions and impact on construction schedule.

2. Review methods and procedures related to metal roof panel assemblies including, but not limited to, the following:

a. Compliance with requirements for purlin and rafter conditions, including flatness and attachment to structural members.
b. Structural limitations of purlins and rafters during and after roofing.
c. Flashings, special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect metal roof panels.
d. Temporary protection requirements for metal roof panel assembly during and after installation.
e. Roof observation and repair after metal roof panel installation.

3. Review methods and procedures related to metal wall panel assemblies including, but not limited to, the following:

a. Compliance with requirements for support conditions, including alignment between and attachment to structural members.
b. Structural limitations of girts and columns during and after wall panel installation.
c. Flashings, special siding details, wall penetrations, openings, and condition of other construction that will affect metal wall panels.
d. Temporary protection requirements for metal wall panel assembly during and after installation.
e. Wall observation and repair after metal wall panel installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of metal building system component.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Metal roof panels.
b. Metal wall panels.

B. Shop Drawings: Indicate components by others. Include full building plan, elevations, sections, details and the following:

1. Anchor-Rod Plans: Submit anchor-rod plans and templates before foundation work begins. Include location, diameter, and minimum required projection of anchor rods required to attach metal building to foundation. Indicate column reactions at each location.
2. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.

3. Metal Roof and Wall Panel Layout Drawings: Show layouts of panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, clip spacing, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.

4. Accessory Drawings: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

    a. Flashing and trim.
    b. Gutters.
    c. Downspouts.
    d. Service walkways.

C. Samples for Verification: For the following products:

1. Panels: Nominal 12 inches long by actual panel width. Include fasteners, closures, and other exposed panel accessories.
2. Flashing and Trim: Nominal 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: Nominal 12-inch-long Samples for each type of accessory.

D. Delegated-Design Submittal: For metal building systems.

1. Include analysis data indicating compliance with performance requirements and design data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For erector and manufacturer.

B. Welding certificates.

C. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design Loads: Include dead load, roof live load, collateral loads, roof snow load, deflection, wind loads/speeds and exposure, seismic design category or effective peak velocity-related acceleration/peak acceleration, and auxiliary loads (cranes).

9. Load Combinations: Indicate that loads were applied acting simultaneously with concentrated loads, according to governing building code.
10. Building-Use Category: Indicate category of building use and its effect on load importance factors.

D. Erector Certificates: For qualified erector, from manufacturer.

E. Material Test Reports: For each of the following products:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shop primers.
5. Nonshrink grout.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panel finishes to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Accreditation: Manufacturer's facility accredited according to the International Accreditation Service's AC472, "Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems."
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a professional engineer who is legally qualified to practice in jurisdiction where Project is located.

B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with panel installation only when weather conditions permit metal panels to be installed according to manufacturers' written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

    a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
    b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal building system components, including primary and secondary framing and metal panel assemblies, from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

A. Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior.

B. Primary-Frame Type:

1. Rigid Clear Span: Solid-member, structural-framing system without interior columns.

C. End-Wall Framing: Manufacturer's standard, for buildings not required to be expandable.

D. Secondary-Frame Type: Manufacturer's standard purlins and joists and exterior-framed (bypass) girts.

E. Eave Height: 16 feet Manufacturer's standard height, as indicated by nominal height on Drawings (14 Feet clear through structure).

F. Bay Spacing: As indicated on Drawings.

G. Roof Slope: 1/2 inch per 12 inches.

H. Roof System: Manufacturer's standard standing-seam, trapezoidal-rib, metal roof panels.

I. Exterior Wall System: Manufacturer's standard exposed-fastener, tapered-rib, metal wall panels.

2.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design metal building system.

1. Design Loads: As indicated on Drawings.
2. Deflection and Drift Limits: Design metal building system assemblies to withstand serviceability design loads without exceeding deflections and drift limits recommended in AISC Steel Design Guide No. 3 "Serviceability Design Considerations for Steel Buildings."

B. Structural Performance for Metal Roof and Wall Panels: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.

C. Water Penetration for Metal Roof Panels: No water penetration when tested according to ASTM E1646 or ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.

1. Uplift Rating: UL 90.
2. Hail Resistance: MH.

2.4 STRUCTURAL-STEEL FRAMING

A. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings."

B. Bolted Connections: Comply with RCSC's "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.

1. General: Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
2. Rigid Clear-Span Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Interior columns are not permitted.
3. Frame Configuration: One-directional, sloped.
4. Exterior Column: Tapered.
5. Rafter: Uniform depth.

E. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating, to comply with the following:

1. Purlins: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; minimum 2-1/2-inch-wide flanges.

    a. Depth: As needed to comply with system performance requirements.
2. Girts: C- or Z-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees from flange, with minimum 2-1/2-inch-wide flanges.

    a. Depth: As required to comply with system performance requirements.

3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from built-up steel plates, steel sheet, or structural-steel shapes; to provide adequate backup for metal panels.

4. Flange Bracing: Minimum 2-by-2-by-1/8-inch structural-steel angles or 1-inch-diameter, cold-formed structural tubing to stiffen primary-frame flanges.
5. Sag Bracing: Minimum 1-by-1-by-1/8-inch structural-steel angles.
6. Base or Sill Angles: Manufacturer's standard base angle, minimum 3-by-2-inch, fabricated from zinc-coated (galvanized) steel sheet.
7. Purlin and Girt Clips: Manufacturer's standard clips fabricated from steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
8. Framing for Openings: Channel shapes; fabricated from cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings and head, jamb, and sill of other openings.
9. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.

F. Bracing: Provide adjustable wind bracing as follows:
1. Rigid Portal Frames: Fabricated from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.

G. Anchor Rods: Headed anchor rods as indicated in Anchor Rod Plan for attachment of metal building to foundation, designed and provided by manufacture.

H. Materials:

1. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
2. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
3. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
4. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low-Alloy Steel (HSLAS) or High-Strength Low-Alloy Steel with Improved Formability (HSLAS-F), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or HSLAS, Grades 45 through 70.
5. Metallic-Coated Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G60 coating designation; mill phosphatized.
6. Metallic-Coated Steel Sheet Prepainted with Coil Coating: Steel sheet, metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, SS, Grades 33 through 80, or HSLAS or HSLAS-F, Grades 50 through 80; with G90 coating designation.

7. Joist Girders: Manufactured according to "Standard Specifications for Joist Girders," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for primary framing.

8. Steel Joists: Manufactured according to "Standard Specifications for Open Web Steel Joists, K-Series," in SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders"; with steel-angle, top- and bottom-chord members, and end- and top-chord arrangements as indicated on Drawings and required for secondary framing.
9. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.

    a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

10. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M,Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

    a. Finish: Hot-dip zinc coating, ASTM F2329, Class C.

11. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

    a. Finish: Mechanically deposited zinc coating, ASTM B695, Class 50 or Mechanically deposited zinc coating, ASTM B695, Class 50, baked-epoxy coated.

12. Unheaded Anchor Rods: ASTM F1554, Grade 36

    a. Configuration: Straight.
    b. Nuts: ASTM A563 heavy-hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436 hardened carbon steel.
    e. Finish: Hot-dip zinc coating, ASTM F2329, Class C or Mechanically deposited zinc coating, ASTM B695, Class 50.

13. Headed Anchor Rods: ASTM F1554, Grade 36.

    a. Configuration: Straight.
    b. Nuts: ASTM A563 heavy-hex carbon steel.
    c. Plate Washers: ASTM A36/A36M carbon steel.
    d. Washers: ASTM F436 hardened carbon steel.
    e. Finish: Hot-dip zinc coating, ASTM F2329, Class C or Mechanically deposited zinc coating, ASTM B695, Class 50.

I. Finish: Factory primed. Apply specified primer immediately after cleaning and pretreating.

1. Clean and prepare in accordance with SSPC-SP2.
2. Coat with manufacturer's standard primer. Apply primer to primary and secondary framing to a minimum dry film thickness of 1 mil.

    a. Prime secondary framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.

2.5 METAL ROOF PANELS

A. Exposed Fastener, Tapered-Rib, Metal Roof Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Exterior Finish: Two-coat fluoropolymer.
    b. Color: As selected by Architect from manufacturer's full range.

2. Major-Rib Spacing: 12 inches o.c.
3. Panel Coverage: 36 inches.
4. Panel Height: 1.25 inches.

B. Finishes:

1. Exposed Coil-Coated Finish:

    a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

2.6 METAL WALL PANELS

A. Exposed-Fastener, Tapered-Rib, Metal Wall Panels: Formed with raised, trapezoidal major ribs and intermediate stiffening ribs symmetrically spaced between major ribs; designed to be installed by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps.

1. Material: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.024-inch nominal uncoated steel thickness. Prepainted by the coil-coating process to comply with ASTM A755/A755M.

    a. Exterior Finish: Two-coat fluoropolymer.
    b. Color: As selected by Architect from manufacturer's full range.

2. Major-Rib Spacing: 12 inches o.c.
3. Panel Coverage: 36 inches.
4. Panel Height: 1.25 inches.

B. Finishes:

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.7 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same material as metal roof panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same material as metal wall panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.

1. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers.

E. Gutters: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, sized according to SMACNA's "Architectural Sheet Metal Manual."

1. Gutter Supports: Fabricated from same material and finish as gutters.
2. Strainers: Bronze, copper, or aluminum wire ball type at outlets.

F. Downspouts: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match metal wall panels. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.

1. Mounting Straps: Fabricated from same material and finish as gutters.

G. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

H. Materials:

1. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.

    a. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM sealing washer.
    b. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with EPDM sealing washers bearing on weather side of metal panels.
    c. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws with hex washer head.
    d. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

2. Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
3. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.
4. Metal Panel Sealants:

a. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene-compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape of manufacturer's standard size.
b. Joint Sealant: ASTM C920; one part elastomeric polyurethane or polysulfide; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended by metal building system manufacturer.

2.8 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.

B. Tolerances: Comply with MBMA's "Metal Building Systems Manual" for fabrication and erection tolerances.

C. Primary Framing: Shop fabricate framing components to indicated size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

1. Make shop connections by welding or by using high-strength bolts.
2. Join flanges to webs of built-up members by a continuous, submerged arc-welding process.
3. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin web or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
4. Weld clips to frames for attaching secondary framing if applicable, or punch for bolts.
5. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary framing with specified primer after fabrication.

D. Secondary Framing: Shop fabricate framing components to indicated size and section by roll forming or break forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

1. Make shop connections by welding or by using non-high-strength bolts.
2. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC-SP 2. Shop prime uncoated secondary framing with specified primer after fabrication.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

1. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

2.9 SOURCE QUALITY CONTROL

A. Special Inspection: Owner will engage a qualified special inspector to perform source quality control inspections and to submit reports.

1. Accredited Manufacturers: Special inspections will not be required if fabrication is performed by an IAS AC472-accredited manufacturer approved by authorities having jurisdiction to perform such Work without special inspection.

a. After fabrication, submit copy of certificate of compliance to authorities having jurisdiction, certifying that Work was performed according to Contract requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with erector present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Before erection proceeds, survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with erector present, for compliance with requirements and metal building system manufacturer's tolerances.

1. Engage land surveyor to perform surveying.

C. Proceed with erection only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition.

B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION OF STRUCTURAL FRAMING

A. Erect metal building system according to manufacturer's written instructions and drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.

D. Base and Bearing 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. 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.
3. 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.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt type and joint type specified.

    a. Joint Type: Snug tightened or pretensioned as required by manufacturer.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.

1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.

H. Steel Joists and Joist Girders: Install joists, girders, and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Standard Specifications and Load Tables for Steel Joists and Joist Girders," joist manufacturer's written instructions, 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. Joist Installation: Bolt joists to supporting steel framework using carbon-steel bolts unless otherwise indicated.
5. 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.

I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.4 METAL PANEL INSTALLATION, GENERAL

A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Examination: Examine primary and secondary framing to verify that structural-panel support members and anchorages have been installed within alignment tolerances required by manufacturer.

1. Examine roughing-in for components and systems penetrating metal panels, to verify actual locations of penetrations relative to seams before metal panel installation.

C. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.

a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.

2. Install metal panels perpendicular to structural supports unless otherwise indicated.
3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Locate metal panel splices over structural supports with end laps in alignment.

6. Lap metal flashing over metal panels to allow moisture to run over and off the material.

D. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.

1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.

E. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

F. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated; or, if not indicated, provide types recommended by metal panel manufacturer.

1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.

3.5 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.

1. Install ridge caps as metal roof panel work proceeds.
2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing recommended by manufacturer.

1. Provide metal-backed sealing washers under heads of exposed fasteners bearing on weather side of metal roof panels.
2. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
3. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels, on side laps of ribbed or fluted metal panels, and elsewhere as needed to make metal panels weatherproof to driving rains.
4. At metal panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

D. Metal Roof Panel Installation Tolerances: Shim and align metal roof panels within installed tolerance of 1/4 inch in 20 feet on slope and location lines and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.6 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
2. Shim or otherwise plumb substrates receiving metal wall panels.
3. When two rows of metal panels are required, lap panels 4 inches minimum.
4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
5. Rigidly fasten base end of metal wall panels and allow eave end free movement for thermal expansion and contraction. Predrill panels.
6. Flash and seal metal wall panels with weather closures at eaves and rakes, and at perimeter of all openings. Fasten with self-tapping screws.
7. Install screw fasteners in predrilled holes.
8. Install flashing and trim as metal wall panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated on Drawings; if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

C. Installation Tolerances: Shim and align metal wall panels within installed tolerance of 1/4 inch in 20 feet, noncumulative; level, plumb, and on location lines; and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.7 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

D. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Provide elbows at base of downspouts to direct water away from building.

3.8 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform field quality

B. Product will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 CLEANING AND PROTECTION

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.

1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or by SSPC-SP 3, "Power Tool Cleaning."
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

D. Metal Panels: Remove temporary protective coverings and strippable films, if any, as metal panels are installed. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

1. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 133419

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 22 05 17

SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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. Sleeves.
2. Grout.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. 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.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. 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."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.

b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves or Stack-sleeve fittings.

2. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION

SECTION 22 05 18

ESCUTCHEONS FOR PLUMBING PIPING

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. Escutcheons.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

B. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.

c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped steel type or split-plate, stamped-steel with concealed hinge.
e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.
g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge.

2. New Piping: One-piece, floor-plate type.
3. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. If during installation any part is broken, then replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 22 05 19

METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections:

1. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
2. Meters and Gauges furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other sections.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer and gage, signed by product manufacturer.

PART 2 - PRODUCTS

2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

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. Palmer - Wahl Instruments Inc.

2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Brass, 7 inches long.

C. Tube: Red or blue reading, mercury filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.2 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.3 PRESSURE GAGES

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. AMETEK, Inc.; U.S. Gauge Div.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
3. Ernst Gage Co.
4. Palmer - Wahl Instruments Inc.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or brass, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.

7. Window: Glass.
8. Ring: Metal.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.4 TEST PLUGS

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. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, oil, gas, and water service at 20 to 200 deg F shall be CR.

E. Test Kit: Furnish one test kit containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Carrying case shall have formed instrument padding.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install thermometers in the inlet and outlet of each domestic, hot-water storage tank.

B. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.

3.2 GAGE APPLICATIONS

A. Install pressure gages for discharge of each pressure-reducing valve and at cooling tower make-up water.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket in vertical position in piping tees where thermometers are indicated.

C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

D. Install remote-mounting pressure gages on panel.

E. Install needle-valve and snubber fitting in piping for each pressure gage.

F. Install test plugs in tees in piping.

G. Install permanent indicators on walls or brackets in accessible and readable positions.

H. Install connection fittings for attachment to portable indicators in accessible locations.

I. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.

J. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION

SECTION 22 05 23.12

BALL VALVES FOR PLUMBING PIPING

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. Brass ball valves.
2. Bronze ball valves.
3. Steel ball valves.
4. PVC ball valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and soldered ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for solder-joint connections.
6. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Handlever: For quarter-turn valves smaller than NPS 4.

H. Valves in Insulated Piping:

1. Include 2-inch stem extensions.
2. Extended operating handles of nonthermal-conductive material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRASS BALL VALVES

A. Brass Ball Valves, Three-Piece with Full Port and Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Jomar Valve.
b. WATTS.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Forged brass.
e. Ends: Threaded and soldered.
f. Seats: PTFE.
g. Stem: Brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

2.3 BRONZE BALL VALVES

A. Bronze Ball Valves, Three-Piece with Full Port and Bronze or Brass Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Alberts Integrated Piping Systems.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Red-White Valve Corp.
f. WATTS.

2. Description:

a. Standard: MSS SP-110.
b. CWP Rating: 600 psig.
c. Body Design: Three piece.
d. Body Material: Bronze.
e. Ends: Threaded.
f. Seats: PTFE.
g. Stem: Bronze or brass.
h. Ball: Chrome-plated brass.
i. Port: Full.

2.4 STEEL BALL VALVES

A. Steel Ball Valves with Full Port, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Alberts Integrated Piping Systems.
b. Jamesbury; Metso.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-72.
b. CWP Rating: 150 psig.
c. Body Design: Split body.
d. Body Material: Carbon steel, ASTM A216, Type WCB.
e. Ends: Flanged or threaded.
f. Seats: PTFE.
g. Stem: Stainless steel.
h. Ball: Stainless steel, vented.
i. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:
1. Bronze ball valves, three-piece with full port and bronze or brass trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full port.

END OF SECTION

SECTION 22 05 23.14

CHECK VALVES FOR PLUMBING PIPING

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. Bronze lift check valves.
2. Bronze swing check valves.
3. Iron swing check valves.
4. Iron, center-guided check valves.
5. PVC ball check valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B16.18 for solder joint.
5. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

G. Valve Sizes: Same as upstream piping unless otherwise indicated.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE LIFT CHECK VALVES

A. Bronze Lift Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane; a Crane brand.
b. Jenkins Valves; Crane Energy Flow Solutions.
c. Stockham; Crane Energy Flow Solutions.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B61 or ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

2.3 BRONZE SWING CHECK VALVES

A. Bronze Swing Check Valves with Bronze Disc, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Crane; a Crane brand.
c. Hammond Valve.
d. Jenkins Valves; Crane Energy Flow Solutions.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corp.
i. Stockham; Crane Energy Flow Solutions.
j. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B62, bronze.
e. Ends: Threaded or soldered. See valve schedule articles.
f. Disc: Bronze.

2.4 IRON SWING CHECK VALVES

A. Iron Swing Check Valves with Metal Seats, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Crane; a Crane brand.
c. Hammond Valve.
d. Jenkins Valves; Crane Energy Flow Solutions.
e. Milwaukee Valve Company.

f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corp.
i. Stockham; Crane Energy Flow Solutions.
j. WATTS.

2. Description:

a. Standard: MSS SP-71, Type I.
b. CWP Rating: 200 psig.
c. Body Design: Clear or full waterway.
d. Body Material: ASTM A126, gray iron with bolted bonnet.
e. Ends: Flanged or threaded. See valve schedule articles.
f. Trim: Bronze.
g. Gasket: Asbestos free.

B. Iron Globe, Center-Guided Check Valves with Metal Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Metraflex Company (The).
c. Milwaukee Valve Company.
d. Mueller Steam Specialty; A WATTS Brand.
e. NIBCO INC.
f. Spence Strainers International.
g. WATTS.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: Bronze.

C. Iron, Compact-Wafer, Center-Guided Check Valves with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Spence Strainers International.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Compact wafer, spring loaded.
e. Seat: EPDM or NBR.

D. Iron Globe, Center-Guided Check Valves with Resilient Seat, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.

2. Description:

a. Standard: MSS SP-125.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A126, gray iron.
d. Style: Globe, spring loaded.
e. Ends: Flanged.
f. Seat: EPDM or NBR.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Check Valves: Install check valves for proper direction of flow.

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. End Connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or soldered or press-ends.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged or threaded.
3. For Copper Tubing, NPS 5 and Larger: Flanged.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze swing check valves with bronze disc, Class 150, with threaded end connections.

B. Pipe NPS 2-1/2 and Larger:

1. Iron swing check valves with metal seats, Class 125, with threaded or flanged end connections.
2. Iron, center-guided check valves with compact wafer, Class 150, with threaded or flanged end connections.

C. CPVC Pipe NPS 2 and Smaller: CPVC ball check valve.

D. PVC Pipe NPS 2 and Smaller: PVC ball check valve.

END OF SECTION

SECTION 22 05 23.15

GATE VALVE FOR PLUMBING PIPING

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. Bronze gate valves.
2. Iron gate valves.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. RS: Rising stem.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1. Certification that products comply with NSF 61 and NSF 372.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set gate valves closed to prevent rattling.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B1.20.1 for threads for threaded end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
4. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 and NSP 372 for valve materials for potable-water service.

D. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. RS Valves in Insulated Piping: With 2-inch stem extensions.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE GATE VALVES

A. Bronze Gate Valves, RS, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Valve, Inc.
b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
c. Crane; a Crane brand.
d. Hammond Valve.
e. Jenkins Valves; Crane Energy Flow Solutions.
f. Milwaukee Valve Company.

g. NIBCO INC.
h. Powell Valves.
i. Stockham; Crane Energy Flow Solutions.
j. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Material: Bronze with integral seat and screw-in bonnet.
d. Ends: Threaded or solder joint.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

B. Bronze Gate Valves, RS, Class 150:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Crane; a Crane brand.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Powell Valves.
g. Stockham; Crane Energy Flow Solutions.
h. WATTS.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: Bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron, bronze, or aluminum.

2.3 IRON GATE VALVES

A. Iron Gate Valves, OS&Y, Class 125:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.

b. Crane; a Crane brand.
c. Hammond Valve.
d. Jenkins Valves; Crane Energy Flow Solutions.
e. Milwaukee Valve Company.
f. NIBCO INC.
g. Powell Valves.
h. Red-White Valve Corp.
i. Stockham; Crane Energy Flow Solutions.
j. WATTS.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: Gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.4 CPVC GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Spears Manufacturing Company.

B. Description:

1. Pressure Rating and Temperature: 150 psig at 73 deg F.
2. Body Material: CPVC.
3. Body Design: Nonrising stem.
4. End Connections for Valves NPS 2 and Smaller: Socket or threaded.
5. End Connections for Valves NPS 2-1/2 to NPS 4: Threaded or Flanged.
6. Gate and Stem: Plastic.
7. Seals: EPDM rubber.
8. Handle: Wheel.

2.5 PVC GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. KBI (King Bros. Industries).
2. Spears Manufacturing Company.

B. Description:

1. Pressure Rating and Temperature: 150 psig at 73 deg F.

2. Body Material: PVC.
3. Body Design: Nonrising stem.
4. End Connections for Valves NPS 2 and Smaller: Socket or threaded.
5. End Connections for Valves NPS 2-1/2 to NPS 4: Threaded or Flanged.
6. Gate and Stem: Plastic.
7. Seals: EPDM rubber.
8. Handle: Wheel.

2.6 CHAINWHEELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries.
3. Trumbull Industries.

B. Description: Valve actuation assembly with sprocket rim, chain guides, chain, and attachment brackets for mounting chainwheels directly to hand wheels.

1. Sprocket Rim with Chain Guides: Ductile or cast iron, of type and size required for valve. Include zinc or epoxy coating.
2. Chain: Hot-dip galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. Use gate valves for shutoff service only.

B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.

C. For Grooved-End Copper Tubing and Steel Piping: Valve ends may be grooved.

3.5 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze gate valves, RS, Class 150 with threaded ends.

B. Pipe NPS 2-1/2 and Larger: Iron gate valves, OS&Y, Class 125 with flanged ends.

C. CPVC Pipe NPS 2 and Smaller: CPVC gate valve.

D. PVC Pipe NPS 2 and Smaller: PVC gate valve.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Thermal-hanger shield inserts.
4. Fastener systems.
5. Pipe stands.
6. Pipe positioning systems.
7. Equipment supports.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 21 fire-suppression piping Sections for pipe hangers for fire-suppression piping.
3. Division 22 Section "Vibration Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.
3. Pipe stands.
4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.8 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
3. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 Section "Roof Accessories" for curbs.

F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

N. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Use thermal-hanger shield insert with clamp sized to match OD of insert.

b. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Red

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. General Requirements for Manufactured Pipe Labels installed in return air plenums: Pipe labels installed in return plenums shall meet the required flame/smoke spread rating required to be plenum rated.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch, Stainless steel, 0.025-inch, Aluminum, 0.032-inch, or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09.

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 feet in areas of congested piping and equipment.
7. Facing down or toward easiest area of view.

C. Pipe Label Color Schedule:

1. Colors shall be according to ASME A13.1.

D. Install tags on valves and control devices in piping systems, except valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

E. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Cold Water: 1-1/2 inches, round.
b. Hot Water: 1-1/2 inches, round.

2. Valve-Tag Color:

a. Cold Water: Green.
b. Hot Water: Orange.

3. Letter Color:

a. Cold Water: White.
b. Hot Water: White.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 22 05 93

TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

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. TAB of domestic water system.
2. TAB of plumbing equipment:

    a. Domestic water booster pumps.
    b. General-duty air compressors.

3. Pipe-leakage test verification.
4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

1.3 DEFINITIONS

A. NEBB: National Environmental Balancing Bureau.

B. TAB: Testing, adjusting, and balancing.

C. TABB: Testing, Adjusting, and Balancing Bureau.

D. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

E. TDH: Total dynamic head.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

    a. The Contract Documents examination report.

b. The TAB plan.
c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. System Readiness Checklists: Within 60 90 Insert number days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.

F. Certified TAB reports.

G. Sample report forms.

H. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. TAB Specialists Qualifications, Certified by NEBB or TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.

E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."

F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.7 FIELD CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, available TAB specialists that may be engaged include, but are not limited to, the following:

1. Command Commisioning.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine approved submittals for plumbing systems and equipment.

D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.

E. Examine equipment performance data, including pump curves.

1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.

F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.

J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine operating safety interlocks and controls on plumbing equipment.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Domestic Water System:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
b. Water heaters are installed and functioning.
c. Piping is complete and all points of outlet are installed.

d. Water treatment is complete.
e. Systems are flushed, filled, and air purged.
f. Strainers are clean.
g. Control valves are functioning in accordance with the sequence of operation.
h. Shutoff and balance valves are 100 percent open.
i. Booster- pumps are operational and proper rotation is verified.
j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
k. Variable-frequency controllers' startup is complete and safeties are verified.
l. Suitable access to balancing devices and equipment is provided.

2. Sanitary Sewage/Drainage System:

a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
b. Piping is complete.
c. Sanitary sewage pumps/drainage pumps are operational.
d. Control valves are functioning in accordance with the sequence of operation.
e. Shutoff valves are 100 percent open.
f. Suitable access to equipment is provided.

3. Compressed-Air System:

a. Leakage and pressure tests on compressed air distribution system have been satisfactorily completed in accordance with Division 22 requirements.
b. Piping is complete and all points of outlet are installed.
c. Systems are flushed, filled, and air purged.
d. Strainers are clean.
e. Control valves are functioning in accordance with the sequence of operation.
f. Shutoff and balance valves are 100 percent open.
g. Compressors are operational and of proper rotation.
h. Gauge connections are installed directly at compressor inlet and outlet flanges prior to valves or strainers.
i. Variable-frequency controllers' startup is complete and safeties are verified.
j. Suitable access to balancing devices and equipment is provided,

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.

2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 22 07 16 "Plumbing Equipment Insulation" and Section 22 07 19 "Plumbing Piping Insulation."

C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Domestic water heaters.
3. Drainage pumps.
4. Air compressors.

3.6 PROCEDURES FOR DOMESTIC WATER SYSTEMS

A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:

1. Check expansion tank for proper setting.
2. Check water heater for proper discharge temperature setting.
3. Check remotest point of outlet for adequate pressure.
4. Check flow-control valves for proper position.
5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
6. Verify that motor controllers are equipped with properly sized thermal protection.
7. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

G. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR COMPRESSED-AIR SYSTEMS

A. Prepare test reports for air compressors, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare compressed-air systems for testing and balancing as follows:

1. Check remotest point of outlet for adequate pressure.
2. Check pressure-control valves for proper position.
3. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
4. Verify that motor controllers are equipped with properly sized thermal protection.

D. Measure and record upstream and downstream pressure of pressure-reducing valves.

E. Check settings and operation of pressure-reducing valves. Record final settings.

F. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR WATER HEATERS

A. Electric Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

B. Fuel-Fired Water Heaters:

1. Measure and record entering- and leaving-water temperatures.
2. Measure and record water flow.
3. Measure and record pressure drop.
4. Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.
7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

3.9 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record flows, temperatures, and pressures of each piece of equipment. Compare the values to design or nameplate information, where information is available.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check bearings and other lubricated parts for proper lubrication.
5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:

1. New filters are installed.
2. Bearings and other parts are properly lubricated.
3. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated system flows of the renovated work to the measured flows, and determine the new pump speed.
2. Verify that the indicated system flows of the renovated work result in velocities and pump speeds that are within the acceptable limits defined by equipment manufacturer.
3. If calculations increase or decrease the system flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.

3.10 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

1. Domestic Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
2. Compressed-Air Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.

3.11 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:

    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).

c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:

1. Flow rates.
2. Pipe and valve sizes and locations.
3. Balancing stations.
4. Position of balancing devices.

5. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Low-fire fuel input in Btu/h.
e. High-fire fuel input in Btu/h.
f. High-temperature-limit setting in deg F.
g. Operating set point in Btu/h.
h. Heating value of fuel in Btu/h.

E. Gas-Fired Water Heaters Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and speed.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Low-fire fuel input in Btu/h.
e. High-fire fuel input in Btu/h.
f. High-temperature-limit setting in deg F.
g. Operating set point in Btu/h.

h. Heating value of fuel in Btu/h.

F. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Model number and unit size.
d. Manufacturer's serial number.
e. Output capacity in Btu/h.
f. Number of stages.
g. Connected volts, phase, and hertz.
h. Rated amperage.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. High-temperature-limit setting in deg F.
e. Operating set point in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

G. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.13 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.

B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION

SECTION 22 07 19

PLUMBING PIPING INSULATION

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. Insulation Materials:
   a. Mineral fiber.
   b. Flexible elastomeric.
   c. Polyolefin.
2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

B. Related Sections include the following:

1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

G. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

D. ASJ Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
4. Color: White.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
2. Service Temperature Range: 0 to 180 deg F.
3. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
4. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
2. Service Temperature Range: Minus 50 to plus 180 deg F.
3. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Permanently flexible, elastomeric sealant.
3. Service Temperature Range: Minus 100 to plus 300 deg F.
4. Color: White or gray.

B. Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants::

1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2.8 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.

2.9 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

2.10 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.

5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.12 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
b. Spindle: Copper- or zinc-coated, low carbon steel or Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

    a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    b. Spindle: Copper- or zinc-coated, low carbon steel or Aluminum, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    c. Adhesive-backed base with a peel-off protective cover.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

    a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.13 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

B. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. 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.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. 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 mastic.
3. 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.
4. 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.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 Section "Penetration Firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe

insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.9 FINISHES

A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be one of the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot (non-Recirculated) Hot Water:

1. Insulation shall be one of the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 1/2 inch thick.
b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inchthick.

D. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

E. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:
a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. PVC,: 20 mils thick.
2. Stainless Steel, Type 304 or 316, Smooth 2B Finish: 0.020 inchthick.

D. Piping, Exposed:

1. PVC,: 20 mils thick.
2. Stainless Steel, Type 304 or 316, Smooth 2B Finish: 0.020 inchthick.

E. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:

1. Aluminum, Smooth: 0.032 inch thick.
2. Stainless Steel, Type 304 or 316, Smooth, with: 0.024 inch thick.

3.13 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 22 11 16

DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.

1.2 SUBMITTALS

A. Product Data: For the following products:

1. Specialty valves.
2. Transition fittings.
3. Dielectric fittings.
4. Flexible connectors.
5. Backflow preventers and vacuum breakers.
6. Water penetration systems.

B. Coordination Drawings: For piping project, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Domestic water piping.
2. HVAC hydronic piping.
3. Lighting
4. HVAC Duct Systems

C. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14 for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61 for potable domestic water piping and components.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Company or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect no fewer than five days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Company's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, annealed temper.
1. Copper Pressure-Seal-Joint Fittings:

a. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
b. NPS 3 and NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

C. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Form: Sheet or Tube.

C. Material: LLDPE film of 0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch minimum thickness.

D. Color: Black.

2.5 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.6 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

D. Plastic-to-Metal Transition Fittings:

1. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions:

1. Description: PVC four-part union. Include brass or stainless-steel threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions:

1. Description:

a. Pressure Rating: 150 psig at 180 deg F.
b. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Description:

a. Factory-fabricated, bolted, companion-flange assembly.
b. Pressure Rating: 150 psig minimum.
c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits:

1. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings:

1. Description:

a. Galvanized-steel coupling.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Female threaded.
d. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples:

1. Description:

a. Electroplated steel nipple complying with ASTM F 1545.
b. Pressure Rating: 300 psig at 225 deg F.
c. End Connections: Male threaded or grooved.
d. Lining: Inert and noncorrosive, propylene.

2.8 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.

2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

G. Install domestic water piping shut that the entire system can be drained.

H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

K. Install piping adjacent to equipment and specialties to allow service and maintenance.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

S. Install sleeve seals for piping penetrations of concrete walls and slabs.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors.

U. All adhesives, coverings, piping, and sealers shall be plenum rated, having a flame-spread index of 25 or less, and smoke-development index of 50 or less, as required by code.

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

E. Copper-Tubing Grooved Joints: Roll groove end of tube. Assemble coupling with housing, gasket, lubricant, and bolts. Join copper tube and grooved-end fittings according to AWWA C606 for roll-grooved joints.

F. Steel-Piping Grooved Joints: Cut or roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. PVC Piping: Join according to ASTM D 2855.

I. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 and smaller and butterfly valves for piping NPS 2-1/2 and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, unions or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4. Use dielectric flanges, flange kits, or nipples.

3.6 FLEXIBLE CONNECTOR INSTALLATION

A. Install flexible connectors in suction and discharge piping connections to each domestic water pump and in suction and discharge manifold connections to each domestic water booster pump.

B. Install bronze-hose flexible connectors in copper domestic water tubing.

C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

G. Install supports for vertical steel piping every 15 feet.

H. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

    a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.
9. Clean and disinfect potable and non-potable domestic water piping as follows:
    a. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
    b. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
        1) Flush piping system with clean, potable water until dirty water does not appear at outlets.
        2) Fill and isolate system according to either of the following:
            a) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
            b) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
        3) Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
        4) Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.12 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: If contractor wishes to use extruded-tee connections and brazed joints on aboveground copper tubing, contractor shall submit a request, in writing, to the engineer. The engineer will review the request and instruct accordingly. This section is not a guarantee that the request will be approved.

D. Under-building-slab, domestic water, building service piping, shall be one of the following:

1. Soft drawn copper tube, ASTM B 88, Type K; silver solder-joint fittings

E. Aboveground domestic water piping, shall be one of the following:

1. Hard copper tube, ASTM B 88, Type K; copper solder-joint fittings;
2. PVC will not be accepted.

3.13 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Wall hydrants (Hose bibs).
9. Post hydrants.
10. Drain valves.
11. Water hammer arresters.
12. Air vents.
13. Trap-seal primer valves.

B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
2. Division 22 Section "Domestic Water Piping" for water meters.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 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 marked for intended use.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze or Chrome plated.

B. Hose-Connection Vacuum Breakers :

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Chrome, nickel plated, or Rough bronze.

C. Pressure Vacuum Breakers :

1. Standard: ASSE 1020.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
4. Accessories:

a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers :

1. Standard: ASSE 1056.
2. Operation: Continuous-pressure applications.
3. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers :

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Body: Bronze.
4. End Connections: Union, solder joint.
5. Finish: Chrome plated or Rough bronze.

B. Reduced-Pressure-Principle Backflow Preventers :

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger, unless specifically scheduled otherwise.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet ofNPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

C. Double-Check Backflow-Prevention Assemblies :

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications, unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Accessories:

    a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

D. Beverage-Dispensing-Equipment Backflow Preventers :

1. Standard: ASSE 1022.
2. Operation: Continuous-pressure applications.
3. Body: Stainless steel.
4. End Connections: Threaded.

E. Dual-Check-Valve Backflow Preventers :

1. Standard: ASSE 1024.

2. Operation: Continuous-pressure applications.
3. Body: Bronze with union inlet.

F. Double-Check, Detector-Assembly Backflow Preventers :

1. Standard: ASSE 1048 and FMG approved or UL listed.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
4. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
5. End Connections: Flanged.
6. Accessories:

   a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
   b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

G. Hose-Connection Backflow Preventers :

1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water back pressure.
3. Inlet Size: NPS 1/2 or NPS 3/4.
4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

H. Backflow-Preventer Test Kits :

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.3 WATER PRESSURE-REDUCING VALVES

A. Water Regulators :

1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 150 psig.
3. Body: Bronze with chrome-plated finish for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
4. Valves for Booster Heater Water Supply: Include integral bypass.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water Control Valves :

1. Description: Pilot-operation, diaphragm-type, single-seated main water control valve.
2. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
3. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.

4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

2.4 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves :

1. Type: Ball valve with two readout ports and memory setting indicator.
2. Body: Brass or bronze,
3. Size: Same as connected piping, but not larger than NPS 2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

C. Memory-Stop Balancing Valves :

1. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 2 or smaller.
4. Body: Copper alloy.
5. Port: Standard or full port.
6. Ball: Chrome-plated brass.
7. Seats and Seals: Replaceable.
8. End Connections: Solder joint or threaded.
9. Handle: Vinyl-covered steel with memory-setting device.

2.5 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices :

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig.
3. Type: Thermostatically controlled water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded inlets and outlet.
6. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Finish: Chrome plated or Rough bronze.

B. Primary, Thermostatic, Water Mixing Valves :

1. Standard: ASSE 1017.
2. Pressure Rating: 125 psig.
3. Type: Exposed-mounting or cabinet-type, thermostatically controlled water mixing valve.
4. Material: Bronze body with corrosion-resistant interior components.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.

8. Valve Finish: Chrome plated, Polished, chrome plated or Rough bronze.
9. Piping Finish: Chrome plated or Copper.

C. Individual-Fixture, Water Tempering Valves :

1. Standard: ASSE 1016, thermostatically controlled water tempering valve.
2. Pressure Rating: 125 psig minimum, unless otherwise indicated.
3. Body: Bronze body with corrosion-resistant interior components.
4. Temperature Control: Adjustable.
5. Inlets and Outlet: Threaded.
6. Finish: Rough or chrome-plated bronze.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers :

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:

    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    c. Strainers NPS 5 and Larger: 0.10 inch.

6. Drain: Factory-installed, hose-end drain valve.

2.7 OUTLET BOXES

A. Icemaker Outlet Boxes :

1. Mounting: Recessed.
2. Material and Finish: Enameled-steel or epoxy-painted-steel or plastic box and faceplate.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
4. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.
5. Include operating key with each operating-key hose bibb.
6. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.8 WALL HYDRANTS (HOSE BIBBS)

A. Nonfreeze Wall Hydrants:

1. Standard: ASME A112.21.3M for concealed or exposed-outlet, as scheduled, self-draining wall hydrants.
2. Pressure Rating: 125 psig.

3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: NPS 3/4 or NPS 1.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounting with cover.
8. Box and Cover Finish: As scheduled.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: As scheduled.
11. Operating Keys(s): Two with each wall hydrant.

2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves :

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters :

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Stainless steel nested bellows.
3. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 AIR VENTS

A. Bolted-Construction Automatic Air Vents :

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents :

1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.12 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves :

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves :

1. Standard: ASSE 1044, lavatory P-trap with NPS 3/8 minimum, trap makeup connection.
2. Size: NPS 1-1/4 minimum.
3. Material: Chrome-plated, cast brass.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.
2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs

H. Install draining-type post hydrants with 1 cu. yd of crushed gravel around drain hole where installations are on ground. Set post hydrants in concrete paving..

I. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

J. Install water hammer arresters in water piping according to PDI-WH 201.

K. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

L. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

M. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

N. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Vacuum breakers.
2. Backflow preventers.
3. Backflow-prevention assemblies.
4. Water pressure-reducing valves.
5. Calibrated balancing valves.
6. Water mixing valves.
7. Supply-type, trap-seal primer valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check backflow-prevention assembly and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

1.2 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.

B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.

C. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

D. Adhesive Primer: ASTM F 656.

1. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Solvent Cement: ASTM D 2564.

1. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SPECIALTY PIPE FITTINGS

A. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

a. Description:

1) Standard: ASSE 1079.
2) Pressure Rating: 125 psig minimum at 180 deg F.
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Nipples:

a. Description:

1) Electroplated steel nipple complying with ASTM F 1545.
2) Pressure Rating: 300 psig at 225 deg F.
3) End Connections: Male threaded or grooved.
4) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:

1. Building Sanitary Drain: 1/4 inch per foot downward in direction of flow for piping NPS 2 and smaller; 1/8 inch per foot downward in direction of flow for piping NPS 3 and larger. All sanitary drains shall be 24” below finished floor.
2. Vent Piping: Slope down toward vertical fixture vent or toward vent stack.

M. Install steel piping according to applicable plumbing code.

N. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Install aboveground PVC piping according to ASTM D 2665.

Q. Install underground PVC piping according to ASTM D 2321. With 4” sand on all sides top and bottom.

R. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.

S. Plumbing Specialties:

1. Install backwater valves in sanitary waste gravity-flow piping. Comply with requirements for backwater valves specified in Division 22 Section "Sanitary Waste Piping Specialties."
2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."

T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

U. Install sleeves for piping penetrations of walls, ceilings, and floors.

V. Install sleeve seals for piping penetrations of concrete walls and slabs.

W. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.2 JOINT CONSTRUCTION

A. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.3 SPECIALTY PIPE FITTING INSTALLATION

A. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.4 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install gate or full-port ball valve for piping NPS 2 and smaller.
3. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Install individual, straight, horizontal piping runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.

F. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.

G. Install supports for vertical copper tubing every 10 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Comply with requirements for backwater valves, cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
6. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.10 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

C. Aboveground, soil and waste piping NPS 5 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

D. Aboveground, vent piping shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.
3. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

E. Underground will extend 12” above ground, soil, waste, and vent piping shall be the following:
1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
2. Dissimilar Pipe-Material Couplings: Unshielded, nonpressure transition couplings.

END OF SECTION

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

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. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Through-penetration firestop assemblies.
   4. Miscellaneous sanitary drainage piping specialties.
   5. Flashing materials.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. 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.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.6 COORDINATION

A. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron, ASME A112.3.1 for stainless steel for cleanout test tee.
3. Size: Same as connected drainage piping
4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch, Hubless, cast-iron soil pipe test tee, Stainless-steel tee with side cleanout as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Josam Company; Josam Div.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Watts Drainage Products Inc.
    e. Zurn Plumbing Products Group

2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Gray iron.
5. Top or Strainer Material: Nickel bronze.
6. Top of Body and Strainer Finish: Nickel bronze.

2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch- minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.5 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft. thickness.
2. Vent Pipe Flashing: 8 oz./sq. ft. thickness.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 75 feet for piping NPS 4 and smaller and 75 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall. For sanitary cleanouts in or near restrooms, place the cleano ut(s) at a higher elevation than the flood rim of the surrounding WC fixtures.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install through-penetration firestop assemblies in plastic conductor and stacks at floor penetrations.

G. Assemble open drain fittings and install with top of hub 2 inches above floor.

H. Install deep-seal traps on floor drains and other waste outlets, if indicated.

I. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

J. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

L. Install wood-blocking reinforcement for wall-mounting-type specialties.

M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

F. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 LABELING AND IDENTIFYING

A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.6 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 13 23

SANITARY WASTE INTERCEPTORS

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. Oil interceptors.
   2. Sand interceptors.
   3. Solids interceptors.
   4. Precast-concrete manhole risers.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PP: Polypropylene.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of metal interceptor. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

   1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   1. Piping connections. Include size, location, and elevation of each.
   2. Interface with underground structures and utility services.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sanitary waste interceptors to include in emergency, operation, and maintenance manuals.

1.7 FIELD CONDITIONS

A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of sewer services without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 OIL INTERCEPTORS

A. Precast Concrete Oil Interceptors: Comply with ASTM C913.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:

    a. Heavy-Traffic Load: Comply with ASTM C890, A-16.

3. Resilient Pipe Connectors: ASTM C923, cast or fitted into interceptor walls, for each pipe connection.
4. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches.
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum-width flange and 26-inch-diameter cover.

    a. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.
    b. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
    c. Include indented top design with lettering cast into cover, using wording equivalent to "INTERCEPTOR."

7. Waste-oil storage tank and piping are specified in Section 23 11 13 "Facility Fuel-Oil Piping."
8. Capacities and Characteristics:

a. See drawing

2.2 SAND INTERCEPTORS

A. Description: Factory-fabricated, cast-iron or steel body and inlet grate; with settlement chamber and removable basket or strainer.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Josam Company.
3. PARK.
4. Rockford Sanitary Systems, Inc.
5. WATTS.
6. Zurn Industries, LLC.

C. Outlet Piping Connection: Hub, hubless, or threaded, unless otherwise indicated.

D. Grate: Cast iron or steel with reinforcement to provide ASTM C890, A-03, walkway load.

E. Capacities and Characteristics:
1. SEE DRAWING

2.3 PRECAST-CONCRETE MANHOLE RISERS

A. Precast Concrete Manhole Risers: ASTM C478, with rubber-gasket joints.

1. Structural Design Loads:

a. Heavy-Traffic Load: Comply with ASTM C890, A-16.

2. Length: From top of underground concrete structure to grade.
3. Riser Sections: 3-inch minimum thickness and 36-inch diameter.
4. Top Section: Eccentric cone unless otherwise indicated. Include top of cone to match grade ring size.
5. Gaskets: ASTM C443, rubber.
6. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals.

B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum-width flange and 26-inch-diameter cover.

1. Ductile Iron: ASTM A536, Grade 60-40-18, unless otherwise indicated.

2. Gray Iron: ASTM A48/A48M, Class 35, unless otherwise indicated.
3. Include indented top design with lettering cast into cover, using wording equivalent to the following:

    a. Grease Interceptors in Sanitary Sewerage System: "INTERCEPTOR."
    b. Oil Interceptors in Sanitary Sewerage System: "INTERCEPTOR."

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 31 20 00 "Earth Moving."

3.2 INSTALLATION

A. Equipment Mounting:

1. Install grease interceptors on cast-in-place concrete equipment base(s).
2. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."

B. Install precast concrete interceptors according to ASTM C891.

C. Set interceptors level and plumb.

D. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

E. Set tops of manhole frames and covers flush with finished surface in pavements.

1. Set tops 3 inches above finish surface elsewhere unless otherwise indicated.

F. Set tops of grating frames and grates flush with finished surface.

G. Install piping and oil storage tanks according to Section 23 11 13 "Facility Fuel-Oil Piping."

H. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
1. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

I. Install grease-removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction.

1. Install control panel adjacent to unit unless otherwise indicated.

J. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Coordinate oil-interceptor storage tank and gravity drain with Section 23 11 13 "Facility Fuel-Oil Piping."

K. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet.

1. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in Section 22 13 16 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

A. Identification materials and installation are specified in Section 31 20 00 "Earth Moving."

1. Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
2. Use warning tapes or detectable warning tape over ferrous piping.
3. Use detectable warning tape over nonferrous piping and over edges of underground structures.

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Grease interceptors.
2. Grease-removal devices.
3. Oil interceptors.
4. Solids interceptors.

3.5 PROTECTION

A. Protect sanitary waste interceptors from damage during construction period.

B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION

typeSECTION 22 15 13

GENERAL-SERVICE COMPRESSED-AIR PIPING

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. This Section includes piping and related specialties for general-service compressed-air systems:

1. Pipes, tubes, and fittings.
2. Joining materials.
3. Valves.
4. Dielectric fittings.
5. Flexible pipe connectors.
6. Specialties.
7. Quick couplings.
8. Hose assemblies.

B. Related Sections include the following:

1. Section 221519 "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. HDPE: High-density polyethylene plastic.

E. NBR: Acrylonitrile-butadiene rubber.

F. PE: Polyethylene plastic.

G. PVC: Polyvinyl chloride plastic.

H. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.4 PERFORMANCE REQUIREMENTS

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Plastic pipes, fittings, and valves.
2. Dielectric fittings.
3. Flexible pipe connectors.
4. Safety valves.
5. Pressure regulators. Include rated capacities and operating characteristics.
6. Automatic drain valves.
7. Filters. Include rated capacities and operating characteristics.
8. Lubricators. Include rated capacities and operating characteristics.
9. Quick couplings.
10. Hose assemblies.

1.6 INFORMATIONAL SUBMITTALS

A. Brazing and welding certificates.

B. Qualification Data: For installers.

C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Extruded-Tee Outlet Procedure: Qualify operators according to the training provided by T-DRILL Industries Inc., for making branch outlets.
2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.
3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to the training provided by Victaulic Company.
4. Joining Procedures for Aluminum Piping Systems: Qualify installers according to the training provided by manufacturers.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.3, "Process Piping," for high- and low-pressure compressed-air piping.
3. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Compressed-Air Service: Do not interrupt compressed-air service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary compressed-air service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than two days in advance of proposed interruption of compressed-air service.
2. Do not proceed with interruption of compressed-air service without Construction Manager's and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

A. Copper Tube: ASTM B88, Type K seamless, Hard drawn-temper, water tube.

1. Wrought-Copper Fittings: ASME B16.22, solder-joint pressure type or MSS SP-73, wrought copper with dimensions for brazed joints.
2. Cast-Copper-Alloy Flanges: ASME B16.24, Class 150 or 300.
3. Copper Unions: ASME B16.22 or MSS SP-123.
4. Press-Type, Copper Tube, Fittings, NPS 2 and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
5. Press-Type, Copper Tube, Fittings, NPS 2-1/2 to NPS 4: Bronze fitting with stainless steel grip ring and EPDM O-ring seal in each end.
6. Extruded-Tee Outlets: Procedure for making branch outlets in copper tube in accordance with ASTM F2014.
7. Grooved-End Fittings and Couplings, Copper:

a. Grooved-End Fittings: ASTM B75/B75M, copper tube or ASTM B584, bronze castings.

b. Grooved-End Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for compressed air, and bolts and nuts. Provide EDPM gasket for oil-free compressed air. Provide NBR gasket if compressed air contains oil or oil vapor.

B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for compressed-air piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 VALVES

A. Metal Ball, Butterfly, Check, and Gate Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A.Y. McDonald Mfg. Co.
b. HART Industrial Unions, LLC.
c. Viega LLC.
d. WATTS.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 150 psig.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Capitol Manufacturing Company.
b. Viega LLC.
c. WATTS.
d. Wilkins.

2. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 150 psig.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Pipeline Seal and Insulator, Inc.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

2.5 FLEXIBLE PIPE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Metraflex Company (The).

B. Bronze-Hose Flexible Pipe Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: 250 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections, NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 250 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.6 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Pilot operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

D. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.

E. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting is indicated.

F. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting is indicated.

G. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting is indicated.

1. Provide with automatic feed device for supplying oil to lubricator.

2.7 QUICK COUPLINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aeroquip Corporation.
2. Milton Industries, Inc.
3. Parker Hannifin Corp.

B. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

C. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.
2. Plug End: Flow-sensor-bleeder, check-valve type with barbed outlet for attaching hose.

D. Valveless Quick Couplings: Straight-through brass body with stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With O-ring or gasket seal, without valve, and with barbed inlet for attaching hose.
2. Plug End: With barbed outlet for attaching hose.

2.8 HOSE ASSEMBLIES

A. Description: Compatible hose, clamps, couplings, and splicers suitable for compressed-air service, of nominal diameter indicated, and rated for 300-psig minimum working pressure, unless otherwise indicated.

1. Hose: Reinforced single-wire-braid, CR-covered hose for compressed-air service.
2. Hose Clamps: Stainless-steel clamps or bands.
3. Hose Couplings: Two-piece, straight-through, threaded brass or stainless-steel O-ring or gasket-seal swivel coupling with barbed ends for connecting two sections of hose.
4. Hose Splicers: One-piece, straight-through brass or stainless-steel fitting with barbed ends for connecting two sections of hose.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Compressed-Air Piping between Air Compressors and Receivers: Use the following piping materials for each size range:
   1. NPS 4 and Smaller: Brazed: Type K, copper tube; wrought-copper fittings; and brazed joints.

B. Low-Pressure Compressed-Air Distribution Piping: Use the following piping materials for each size range:
   1. NPS 4 and Smaller: Brazed: Type K, copper tube; wrought-copper fittings; and brazed joints.

C. Drain Piping: Use one of the following piping materials:
   1. NPS 2 and Smaller: Brazed: Type K, copper tube; wrought-copper fittings; and brazed joints.

3.2 VALVE APPLICATIONS

A. Metal General-Duty Valves: Comply with requirements and use valve types specified in "Valve Applications" Articles in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping," according to the following:

   1. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.
   2. Equipment Isolation NPS 2 and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.
   3. Grooved-end valves may be used with grooved-end piping and grooved joints.

B. General-Duty Valves for Aluminum Piping System: Provide valves, made by piping system manufacturer, that are compatible with piping.

   1. Ball Valves, NPS 2 and Smaller: NPT threaded ends, or push-connect bite ring ends.
   2. Butterfly Valves, NPS 2-1/2 and Larger: Tube to tube, with two roll-groove end couplings.

C. Plastic General-Duty Valves: Provide valves, made by piping manufacturer, that are compatible with piping. Do not use plastic valves between air compressors and receivers.

   1. Blue ABS Piping System: Ball and butterfly valves.
   2. Green ABS Piping System: Ball valves.
   3. HDPE Piping System: Ball valves.

3.3 PIPING INSTALLATION, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited, unless otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:

1. Use steel companion flange with gasket for connection to steel pipe.
2. Use cast-copper-alloy companion flange with gasket and brazed or soldered joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Extended-tee outlets with brazed branch connection may be used for copper tubing, within extruded-tee connection diameter to run tube diameter ratio for tube type, according to Extruded Tee Connections Sizes and Wall Thickness for Copper Tube (Inches) Table in ASTM F2014.

K. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

L. Install branch connections to compressed-air mains from top of main. Provide drain/dirt leg and drain trap at end of each main and branch and at low points.

M. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

N. Install piping to permit valve servicing.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install seismic restraints on piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints for Steel Piping: Join according to AWS D10.12/D10.12M.

E. Brazed Joints for Copper Tubing: Join according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Join according to ASTM B828 or CDA's "Copper Tube Handbook."

G. Extruded-Tee Outlets for Copper Tubing: Form branches according to ASTM F2014, with tools recommended by procedure manufacturer, and using operators qualified according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Use asbestos-free, nonmetallic gasket suitable for compressed air. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

I. Grooved Joints: Assemble couplings with housing, gasket, lubricant, and bolts. Join according to AWWA C606 for grooved joints. Do not apply lubricant to prelubricated gaskets.

J. Heat-Fusion Joints for PE Piping: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657 for socket-fusion joints.

K. Pressure-Sealed Joints: Join with tools recommended by fitting manufacturer, using operators qualified according to Part 1 "Quality Assurance" Article.

L. Dissimilar Metal Piping Material Joints: Use dielectric fittings.

3.5 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," Section 220523.14 "Check Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.6 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. NPS 2 and Smaller: Use dielectric unions.

C. NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.7 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.

C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.8 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressors.

C. Install air-line pressure regulators in branch piping to equipment.

D. Install automatic drain valves on aftercoolers, receivers, and dryers. Discharge condensate onto nearest floor drain.

E. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters. Mount on wall at locations indicated.

F. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters. Mount on wall at locations indicated.

G. Install air-line lubricators in branch piping to machine tools. Mount on wall at locations indicated.

H. Install quick couplings at piping terminals for hose connections.

I. Install hose assemblies at hose connections.

3.9 CONNECTIONS

A. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

B. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 HANGER AND SUPPORT INSTALLATION

A. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

B. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

C. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

D. Vertical Piping: MSS Type 8 or 42, clamps.

E. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet or Less: MSS Type 1, adjustable, steel clevis hangers.
2. Longer Than 100 Feet : MSS Type 43, adjustable roller hangers.

F. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

G. Base of Vertical Piping: MSS Type 52, spring hangers.

H. Support horizontal piping within 12 inches of each fitting and coupling.

I. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

J. Install hangers for Schedule 40, steel piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 3/4 to NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 12 feet with 3/8-inch rod.
3. NPS 2: 13 feet with 3/8-inch rod.
4. NPS 2-1/2: 14 feet with 1/2-inch rod.
5. NPS 3: 15 feet with 1/2-inch rod.
6. NPS 4: 17 feet with 5/8-inch rod.

K. Install supports for vertical, Schedule 40, steel piping every 15 feet.

L. Use manufacturer's recommended hangers and supports for aluminum piping system.

1. Description: Wire rope using adjustable camlock system with standard threaded stud for connection to provided hangers.
2. Hangers: UV-stabilized nylon and galvanized clevis style.
3. Install hangers for aluminum piping every 8 feet.
4. Install supports for vertical aluminum piping every 8 feet.
5. NPS 3 and NPS 4: 96 inches with 1/2-inch rod.

3.11 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

3.12 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.
2. Repair leaks and retest until no leaks exist.
3. Inspect filters lubricators and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION

SECTION 22 33 00

ELECTRIC, DOMESTIC-WATER HEATERS

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. Flow-control, electric, tankless, domestic-water heaters.
   2. Thermostat-control, electric, tankless, domestic-water heaters.
   3. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

   1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, on which the items described in this Section are shown and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for commercial domestic-water heaters, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Product Certificates: For each type of tankless electric, domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Electric, Tankless, Domestic-Water Heaters: 5 year(s).
b. Expansion Tanks: 5 years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. Seismic Performance: Commercial, electric, domestic-water heaters shall withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

2.3 ELECTRIC, TANKLESS, DOMESTIC-WATER HEATERS

A. Thermostat-Control, Electric, Tankless, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Bradford White Corporation.
    b. Bradley Corporation.
    c. Chronomite Laboratories, Inc; a division of Morris Group International.
    d. Eemax, Inc.; a Rheem brand.

2. Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
4. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.

    a. Connections: ASME B1.20.1 pipe thread.
    b. Pressure Rating: 150 psi.
    c. Heating Element: Resistance heating system.
    d. Temperature Control: Thermostat.
    e. Safety Control: High-temperature-limit cutoff device or system.
    f. Jacket: Aluminum or steel with enameled finish or plastic.

5. Support: Bracket for wall mounting.
6. Accessories: Recessed wall box with disconnect.
7. Capacity and Characteristics: as scheduled.

2.4 DOMESTIC-WATER HEATER ACCESSORIES

A. All water heaters shall comply with the standard ASSE 1070-2015

B. Piping-Type Heat Traps: Field-fabricated piping arrangement in accordance with ASHRAE 90.1

C. Heat-Trap Fittings: ASHRAE/IES 90.1

D. Manifold Kits: Domestic-water-heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and memory-stop balancing valves to provide balanced flow through each domestic-water heater.

1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."
2. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

E. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.

F. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

G. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

I. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

J. Domestic-Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 18 inches above the floor.

K. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION Retain option in "Electric, Tankless, Domestic-Water Heater Mounting" Paragraph below if domestic-water heaters (possible source of ignition) will be installed in a location where hazardous fumes can accumulate.

A. Electric, Tankless, Domestic-Water Heater Mounting: Install electric, tankless, domestic-water heaters at least 18 inches on wall bracket.

1. Maintain manufacturer's recommended clearances.
2. Arrange units so controls and devices that require servicing are accessible.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

G. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

H. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

I. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 22 11 19 "Domestic Water Piping Specialties."

J. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

K. Fill electric, domestic-water heaters with water.

L. Use hard cooper pipe to and from the water heater if distance is more than 12”. N Use the size specified.

M. Install 2” sound insulation to cover the equipment. Use Fiberglass rigid board or acoustic foam open cell with felt lamination.

N. Charge domestic-water expansion tanks with air to required system pressure.

O. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 22 11 16 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections.

E. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

F. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train] Owner's maintenance personnel to adjust, operate, and maintain tankless, electric, domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION

SECTION 22 34 00

FUEL-FIRED, DOMESTIC-WATER HEATERS

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. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

   1. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial, gas-fired, domestic-water heater, from manufacturer.

B. Source quality-control reports.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including storage tank and supports.
b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Two year(s).

b. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 Domestic-Water Heaters

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Lochinvar, LLC.
    b. PVI Industries, LLC.
    c. Rheem Manufacturing Company.
    d. Smith, A. O. Corporation.
    e. State Industries.

2. Standard: ANSI Z21.10.3/CSA 4.3.
3. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions.
4. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.

    a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

        1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

    b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

5. Factory-Installed Storage-Tank Appurtenances:

    a. Anode Rod: Replaceable magnesium.
    b. Dip Tube: Required unless cold-water inlet is near bottom of tank.
    c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
    e. Jacket: Steel with enameled finish.
    f. Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
    g. Temperature Control: Adjustable thermostat.
    h. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
    i. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

2.2 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:
   1. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
   2. Construction:

      a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
      b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Air-Charging Valve: Factory installed.

   3. Capacity and Characteristics:

      a. Working-Pressure Rating: 150 psig.
      b. Capacity Acceptable: 5 gal. Minimum.

B. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

   1. Comply with requirements for balancing valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

C. Gas Shutoff Valves: ANSI Z21.15/CSA 9.1-M, manually operated. Furnish for installation in piping.

D. Gas Pressure Regulators: ANSI Z21.18/CSA 6.3, appliance type. Include 5-psigpressure rating as required to match gas supply.

E. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

   1. Gas-Fired, Domestic-Water Heaters: ANSI Z21.22/CSA 4.4-M.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.

B. Install domestic-water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping," Section 22 05 23.13 "Butterfly Valves for Plumbing Piping," and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 22 11 19 "Domestic Water Piping Specialties."

F. Install thermometer on outlet piping of domestic-water heaters. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

G. Assemble and install piping accessories as shown on plans including but not limited to thermostatic mixing valve.

H. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

I. Fill domestic-water heaters with water.

J. Charge domestic-water compression tanks with air.

3.2 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Section 22 11 16 "Domestic Water Piping."

B. Comply with requirements for gas piping specified in Section 23 11 23 "Facility Natural-Gas Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 01 40 00 "Quality Requirements" for retesting and reinspecting requirements and Section 01 73 00 "Execution" for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, domestic-water heaters.

END OF SECTION 22 34 00

SECTION 22 40 00

PLUMBING FIXTURES

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. This Section includes the following conventional plumbing fixtures and related components:

1. Faucets for lavatories, showers and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Interceptors.
7. Dishwasher air-gap fittings.
8. Disposers.
9. Water closets.
10. Urinals.
11. Lavatories.
12. Kitchen sinks.

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
2. Division 22 Section "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PVC: Polyvinyl chloride plastic.

H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. 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.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; and the Texas Accessibility Standards for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.

2. Plastic Shower Enclosures: ANSI Z124.2.
3. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
4. Slip-Resistant Bathing Surfaces: ASTM F 462.
5. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
6. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
7. Stainless-Steel Residential Sinks: ASME A112.19.3.
8. Vitreous-China Fixtures: ASME A112.19.2M.
9. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
10. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for bathtub bathtub/shower and shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
4. Faucets: ASME A112.18.1.
5. Hand-Held Showers: ASSE 1014.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.

4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Disposers: ASSE 1008 and UL 430.
2. Dishwasher Air-Gap Fittings: ASSE 1021.
3. Flexible Water Connectors: ASME A112.18.6.
4. Floor Drains: ASME A112.6.3.
5. Grab Bars: ASTM F 446.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Hot-Water Dispensers: ASSE 1023 and UL 499.
8. Off-Floor Fixture Supports: ASME A112.6.1M.
9. Pipe Threads: ASME B1.20.1.
10. Plastic Shower Receptors: ANSI Z124.2.
11. Plastic Toilet Seats: ANSI Z124.5.
12. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 WARRANTY

1. Warranty Period for Commercial Applications: Three year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
5. Toilet Seats: Equal to 5 percent of amount of each type installed.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

A. Lavatory Faucets

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies, Inc.
b. Chicago Faucets.
c. Elkay Manufacturing Co.
d. Just Manufacturing Company.
e. Kohler Co.
f. Bradley.
g. Zurn Plumbing Products Group

2. Description: Single-control mixing and/or Two-handle mixing valve. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: General-duty, solid brass or copper or brass underbody with brass cover plate.
b. Finish: As noted in schedule or architect approved.
c. Maximum Flow Rate: As noted in schedule
d. Centers: As noted in schedule.
e. Valve Handle(s): As noted in schedule.
f. Inlet(s): NPS 3/8 tubing
g. Spout: As noted in schedule.
h. Spout Outlet: Aerator
i. Operation: As noted in schedule.
j. Drain: Grid
k. Tempering Device: As noted in schedule or on drawings.

2.2 SHOWER FAUCETS

A. Shower Faucets

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
a. Chicago Faucets.
b. Grohe America, Inc.
c. Lawler Manufacturing Co., Inc.
d. T & S Brass and Bronze Works, Inc.
e. Zurn
f. American Standard

2. Description: Single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.

2.3 SINK FAUCETS

A. Sink Faucets

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies, Inc.
b. Chicago Faucets.
c. Sloan
d. Elkay Manufacturing Co.
e. Just Manufacturing Company.
f. Kohler Co.
g. Speakman Company.
h. Zurn Plumbing Products Group; Commercial Brass Operation.

2. Description: As noted in schedule. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.

a. Body Material: Commercial, solid brass or as scheduled.
b. Finish: Polished chrome plate or architect approved finish.
c. Maximum Flow Rate: 2.5 gpm , unless otherwise indicated.
d. Mixing Valve: As noted in schedule.
e. Backflow Protection Device for Side Spray: Required.
f. Centers: As noted in schedule.
g. Handle(s): As noted in schedule.
h. Inlet(s): NPS 3/8 tubing
i. Spout Type: As noted in schedule.
j. Spout Outlet: Aerator.
k. Operation: As noted in schedule.
l. Drain: As noted in schedule.

2.4 FLUSHOMETERS

A. Flushometers

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Sloan Valve Company Model Solis only.
b. No alternates will be accepted.

2. Description: Flushometer for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.

2.5 TOILET SEATS

A. Toilet Seats

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies, Inc.
b. Church Seats.
c. Eljer.
d. Kohler Co.

2. Description: Toilet seat for water-closet-type fixture.

2.6 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Engineered Brass Co.
b. McGuire Manufacturing Co., Inc.
c. Plumberex Specialty Products Inc.
d. TRUEBRO, Inc.
e. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. TRUEBRO, Inc.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.7 FIXTURE SUPPORTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
5. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Water-Closet Supports

1. Description: Combination carrier designed for accessible and standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports

1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports

1. Description: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Sink Supports

1. Description: Type II, sink carrier with hanger plate, bearing studs, and tie rod for sink-type fixture. Include steel uprights with feet.

2.8 DISHWASHER AIR-GAP FITTINGS

A. Dishwasher Air-Gap Fittings

1. Description: Fitting suitable for use with domestic dishwashers and for deck mounting; with plastic body, chrome-plated brass cover; and capacity of at least 5 gpm; and inlet pressure of at least 5 psig at a temperature of at least 140 deg F. Include 5/8-inch- ID inlet and 7/8-inch- ID outlet hose connections.
2. Hoses: Rubber and suitable for temperature of at least 140 deg F.

2.9 WATER CLOSETS

A. Water Closets

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Standard Companies, Inc.
   b. Crane Plumbing, L.L.C./Fiat Products.
   c. Eljer.
   d. Kohler Co.
   e. TOTO USA, Inc.

2.10 URINALS

A. Urinals

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies, Inc.
b. Crane Plumbing, L.L.C./Fiat Products.
c. Kohler Co.
d. TOTO USA, Inc.

2.11 LAVATORIES

A. Lavatories

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. American Standard Companies, Inc.
b. Crane Plumbing, L.L.C./Fiat Products.
c. Kohler Co.
d. Sloan
e. TOTO USA, Inc.
f. Bradley

2.12 KITCHEN SINKS

A. Kitchen Sinks

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Elkay Manufacturing Co.
b. Just Manufacturing Company.
c. Kohler Co.
d. Moen, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.

G. Install counter-mounting fixtures in and attached to casework.

H. Install fixtures level and plumb according to roughing-in drawings.

I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

M. Install toilet seats on water closets.

N. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

O. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

P. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

Q. Install shower flow-control fittings with specified maximum flow rates in shower arms.

R. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

S. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

T. Install dishwasher air-gap fitting at each sink indicated to have air-gap fitting. Install on countertop at sink. Connect inlet hose to dishwasher and outlet hose to disposer.

U. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."

V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 45 00

EMERGENCY PLUMBING FIXTURES

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. Eyewash equipment.
   2. Eye/face wash equipment.
   3. Combination units.
   4. Water-tempering equipment.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings:

   1. Include plans, elevations, sections, and mounting details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
   4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 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. Flushing-Fluid Solution: Separate lot and equal to at least 200 percent of amount of solution installed for each self-contained unit.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ISEA Standard: Comply with ISEA Z358.1.

C. NSF Standard: Comply with NSF 61 and NSF 372, for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC A117.1,; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

2.2 EYEWASH EQUIPMENT

A. Standard, Plumbed Eyewash Units,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Bradley Corporation.
b. Speakman Company.
c. Guardian

d. HAWS

2. Capacity: Not less than 0.4 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Paddle.
5. Spray-Head Assembly: Two receptor-mounted spray heads.
6. Receptor: Chrome-plated brass or stainless-steel bowl.
7. Drain Piping:

   a. Size: NPS 1-1/4 minimum.
   b. Finish: Chrome-plated brass.
   c. Fittings: Receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2/CSA B125.2.

8. Mounting: Deck.

2.3 EYE FACE SHOWER HEAD

A. Standard, floor-Mounted, Plumbed Eye/shower wash Units,:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Bradley Corporation.
   b. Speakman Company.
   c. Guardian
   d. HAWS

2. Capacity: Not less than 0.4 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Paddle.
5. Spray-Head Assembly: Two receptor-mounted spray heads.
6. Receptor: Chrome-plated brass or stainless-steel bowl.
7. Drain Piping:

   a. Size: NPS 1-1/4 minimum.
   b. Finish: Chrome-plated brass.
   c. Fittings: Receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2/CSA B125.2.

8. Mounting: Wall bracket support.

2.4 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures, to facilitate maintenance of the equipment. Use ball or gate valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Section 22 05 23.12 "Ball Valves for Plumbing Piping" and Section 22 05 23.15 "Gate Valves for Plumbing Piping."

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install shutoff valve and strainer in steam piping and shutoff valve in condensate return piping. Comply with requirements for steam and condensate piping specified in Section 23 22 13 "Steam and Condensate Heating Piping" and Section 23 22 16 "Steam and Condensate Heating Piping Specialties."

F. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Section 22 11 16 "Domestic Water Piping."

G. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Section 22 05 19 "Meters and Gages for Plumbing Piping."

H. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

I. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

J. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

K. Fill self-contained fixtures with flushing fluid.

3.3 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Section 22 11 16 "Domestic Water Piping."

B. Connect hot- and cold-water-supply piping to hot- and cold-water, water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures. Comply with requirements for hot- and cold-water piping specified in Section 22 11 16 "Domestic Water Piping."

C. Connect cold water and electrical power to electric heating water-tempering equipment. Comply with requirements for cold-water piping specified in Section 22 11 16 "Domestic Water Piping."

D. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Section 22 13 16 "Sanitary Waste and Vent Piping."

E. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

F. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION

SECTION 22 47 13

DRINKING FOUNTAINS

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 drinking fountains and related components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of drinking fountain.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include operating characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For drinking fountains to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 DRINKING FOUNTAINS

A. Drinking Fountain with Bottle-Filling Station: Surface-mounted.
1. Standards:

a. Comply with ASME A112.19.3/CSA B45.4.
b. Comply with NSF 61 and NSF 372.
c. Comply with ICC A117.1.

2. Cabinet: stainless steel.

3. Type: Vandal resistant

4. Bottle Filler: Sensor activation, with 20-second automatic shut-off timer. Fill rate 0.5 to 1.5 gpm (0.03155 to 0.09464 L/s).
5. Drain: Grid type with NPS 1-1/4 (DN 32) tailpiece.
6. Supply: NPS 3/8 (DN 10) with shutoff valve.
7. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 (DN 32) brass P-trap.
8. Support: Type I water cooler carrier
9. Bottle-Filling Station Mounting Height: Standard
10. Drinking Fountain Mounting Height: High/low – accessible in accordance with ICC A117.1
11. Electrical Characteristics:
    a. Volts: 120 V ac.
    b. Phase: Single.
    c. Hertz: 60 Hz.

2.2 SUPPORTS

A. Type I Water Cooler Carrier:
   1. Standard: ASME A112.6.1M.

B. Type II Water Cooler Carrier:
   1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.

B. Set pedestal drinking fountains on floor.

C. Install recessed drinking fountains secured to wood blocking in wall construction.

D. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

E. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they

can be easily reached for operation. Valves are specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

F. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

G. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

H. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Install ball or gate shutoff valve on water supply to each fixture. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping" and Section 220523.15 "Gate Valves for Plumbing Piping."

D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

C. Provide protective covering for installed fixtures.

D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Premium efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Rotor: Random-wound, squirrel cage.

E. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating.

G. Insulation: Class F.

H. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

I. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.

3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION

SECTION 23 05 17

SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

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. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

B. Related Requirements:

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.

B. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

C. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends and integral welded waterstop collar.

D. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

E. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Jay R. Smith Mfg Co; a division of Morris Group International.
2. Zurn Industries, LLC.

B. Description: Manufactured, galvanized cast-iron sleeve with integral cast flashing flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20-psig.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. GPT; an EnPro Industries company.
4. Metraflex Company (The).
5. Proco Products, Inc.

B. Description:

1. Manufactured plastic, sleeve-type, waterstop assembly, made for imbedding in concrete slab or wall.
2. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GE Construction Sealants; Momentive Performance Materials Inc.
b. Pecora Corporation.
c. Permathane®/Acryl-R®; ITW Polymers Sealants North America.
d. Polymeric Systems, Inc.
e. Sherwin-Williams Company (The).
f. The Dow Chemical Company.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. 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.

C. 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.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with

requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.
   1. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
   2. Install section of cast-iron soil pipe to extend sleeve to 3 inches above finished floor level.
   3. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   4. Using waterproof silicone sealant, seal space between top hub of stack-sleeve fitting and pipe.

B. Fire-Resistance-Rated, Horizontal Assembly, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 07 84 13 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings as new walls and slabs are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout or silicone sealant, seal space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls Above Grade:

    a. Piping Smaller Than NPS 6 : Galvanized Steel pipe sleeves.

2. Concrete Slabs-on-Grade:

    a. Piping Smaller Than NPS 6: Steel pipe sleeves with sleeve-seal system.

        1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6 and Larger: Steel pipe sleeves with sleeve-seal system.

3. Interior Partitions:

    a. Piping Smaller Than NPS 6: Steel pipe sleeves.
    b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION

SECTION 23 05 18

ESCUTCHEONS FOR HVAC PIPING

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. Escutcheons.
2. Floor plates.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
3. Jones Stephens Corp.
4. Keeney Manufacturing Company (The).
5. Mid-America Fittings, Inc.
6. ProFlo; a Ferguson Enterprises, Inc. brand.

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

C. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed and exposed-rivet hinge; and spring-clip fasteners.

2.3 FLOOR PLATES

A. Split Floor Plates: Steel with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
d. Insulated Piping: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
g.

h. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

i. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge or split-plate, stamped steel with exposed-rivet hinge with polished, chrome-plated finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: Split floor plate.
2.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Equipment stands.
6. Equipment supports.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping" for pipe guides and anchors.
3. Section 23 31 13 "Metal Ducts" for duct hangers and supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 QUALITY ASSURANCE

A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code, Section IX.

C. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

D. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

E. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.

B. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated, or epoxy powder-coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.

5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Copper Pipe and Tube Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-plated steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-plated steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. B-line; Eaton, Electrical Sector.
   b. Flex-Strut Inc.
   c. Unistrut; Atkore International.

2. Description: Shop- or field-fabricated, pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channels: Continuous slotted carbon-steel channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of galvanized steel.
8. Metallic Coating: Hot-dip galvanized.

2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type anchors for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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. B-line; Eaton, Electrical Sector.
   b. Hilti, Inc.

c. MKT Fastening, LLC.

2. Indoor Applications: Zinc-coated steel.
3. Outdoor Applications: Stainless steel.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 OUTDOOR EQUIPMENT STANDS

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. Eberl Iron Works, Inc.
2. MIRO Industries.
3. RectorSeal HVAC; a CSW Industrials Company.

2.8 MATERIALS

A. Aluminum: ASTM B221.

B. Carbon Steel: ASTM A1011/A1011M.

C. Structural Steel: ASTM A36/A36M, carbon-steel plates, shapes, and bars; galvanized.

D. Stainless Steel: ASTM A240/A240M.

E. Threaded Rods: Continuously threaded. Zinc-plated or galvanized steel for indoor applications and stainless steel for outdoor applications. Mating nuts and washers of similar materials as rods.

F. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A36/A36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled strut systems.

D. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

F. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

G. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

H. Install lateral bracing with pipe hangers and supports to prevent swaying.

I. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

L. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze, pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless steel pipe hangers and stainless steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.

P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Minimum sixteen gauge galvanized metal insulation saddles, 18 inches long, shall be used at all hangers and point of support.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Stencils.
6. Valve tags.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve-numbering scheme.

E. Valve Schedules: Provide for each piping system. Include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
2. Letter and Background Color: As indicated for specific application under Part 3.
3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless steel rivets or self-taping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA70E and other applicable codes and standards.

I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings. Also include the following:

1. Duct size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution ducts. Arrows may be either integral with label or may be applied separately.
3. Lettering Size: At least 1-1/2 inches high.

2.5 STENCILS

A. Stencils for Piping:
1. Lettering Size: At least 1-1/2 inches high.
2. Stencil Material: Aluminum, brass, or fiberboard.
3. Stencil Paint: Exterior, gloss, acrylic enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
5. Letter and Background Color: As indicated for specific application under Part 3.

B. Stencils for Ducts:
1. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances of up to 15 ft. and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Aluminum.
3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
5. Letter and Background Color: Color as indicated for specific application under Part 3.

C. Stencils for Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:
1. Lettering Size: Minimum letter height of 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.
2. Stencil Material: Aluminum.
3. Stencil Paint: Exterior, gloss, acrylic enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: Exterior, acrylic enamel. Paint may be in pressurized spray-can form.
5. Letter and Background Color: As indicated for specific application under Part 3.

2.6 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass link chain or beaded chain or S-hook.

B. Letter and Background Color: As indicated for specific application under Part 3.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

2.7 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

2.8 INSTALLATION, GENERAL REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

2.9 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

A. Permanently fasten labels on each item of mechanical equipment.

B. Sign and Label Colors:

1. White letters on an ANSI Z535.1 safety-blue background.

C. Locate equipment labels where accessible and visible.

D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

2.10 INSTALLATION OF PIPE LABELS

A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

B. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels,

complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. At access doors, manholes, and similar access points that permit view of concealed piping.
3. Within 3 ft. of equipment items and other points of origination and termination.
4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.

D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.

E. Flow-Direction Arrows: Use arrows to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

F. Pipe-Label Color Schedule:
1. Refrigerant Piping: White letters on an ANSI Z535.1 safety-blue background.
2. Potable and Other Water: White letters on an ANSI Z535.1 safety-green background.
3. Compressed Air: White letters on an ANSI Z535.1 safety-blue background.

2.11 INSTALLATION OF DUCT LABELS

A. Install plastic-laminated duct labels showing service and flow direction with permanent adhesive on air ducts.

1. Provide labels in the following color codes:

a. For air supply ducts: White letters on blue background.
b. For air return ducts: White letters on yellow background**.**
c. For exhaust-, outside-, relief-, return-, and mixed-air ducts: White letters on green background.

B. Stenciled Duct-Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.

1. For all air ducts: Black letters on white background.

C. Locate label near each point where ducts enter into and exit from concealed spaces and at maximum intervals of 20 ft. where exposed or are concealed by removable ceiling system.

D. Stenciled Access Panels and Door Labels, Equipment Labels, and Similar Operational Instructions:

1. Black letters on White background.

2.12 INSTALLATION OF VALVE TAGS

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below.

1. Valve-Tag Size and Shape:

a. Refrigerant: 1-1/2 inches, round.
b. Gas: 1-1/2 inches, round.

2. Valve-Tag Colors:

a. For each piping system, use the same lettering and background coloring system on valve tags as used for the Pipe Label Schedule text and background.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

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. Testing, Adjusting, and Balancing of Air Systems:

a. Constant-volume air systems.

2. Testing, adjusting, and balancing of equipment.

3. Duct leakage test verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

1.4 PREINSTALLATION MEETINGS

A. TAB Conference: Conduct a TAB conference after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.

1. Minimum Agenda Items:

a. The Contract Documents examination report.
b. The TAB plan.

c. Needs for coordination and cooperation of trades and subcontractors.
d. Proposed procedures for documentation and communication flow.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.

D. Certified TAB reports.

E. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.6 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by NEBB or TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine ceiling plenums and underfloor air plenums used for HVAC to verify that they are properly separated from adjacent areas and sealed.

F. Examine equipment performance data, including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

K. Examine operating safety interlocks and controls on HVAC equipment.

L. Examine control dampers for proper installation for their intended function of isolating, throttling, diverting, or mixing air flows.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Verify that leakage and pressure tests on air distribution systems have been satisfactorily completed.
b. Duct systems are complete with terminals installed.
c. Volume, smoke, and fire dampers are open and functional.
d. Clean filters are installed.
e. Fans are operating, free of vibration, and rotating in correct direction.
f. Variable-frequency controllers' startup is complete and safeties are verified.
g. Automatic temperature-control systems are operational.
h. Ceilings are installed.
i. Windows and doors are installed.
j. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.

B. Comply with requirements in ASHRAE 62.1, Section 7.2.2 “Air Balancing”.

C. Contractor shall make all necessary adjustments to assure proper balance of air within limits recommended in AABC National Standards.

D. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.

3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 07 13 "Duct Insulation," Section 23 07 16 "HVAC Equipment Insulation," and Section 23 07 19 "HVAC Piping Insulation."

E. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

F. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Fans and ventilators.
3. Furnaces.
4. Unit heaters.
5. Condensing units.
6. Energy-recovery units.
7. Dedicated outdoor-air units.
8. Split-system air conditioners.
9. Variable-refrigerant-flow systems.
10. Heat pumps.
11. Dust collector.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. 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.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

    a. Set outside-air, return-air, and relief-air dampers for proper position that simulates minimum outdoor-air conditions.
    b. Where duct conditions allow, measure airflow by main Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses close to the fan and prior to any outlets, to obtain total airflow.
    c. Where duct conditions are unsuitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

2. Measure fan static pressures as follows:

    a. Measure static pressure directly at the fan outlet or through the flexible connection.
    b. Measure static pressure directly at the fan inlet or through the flexible connection.
    c. Measure static pressure across each component that makes up the air-handling system.
    d. Report artificial loading of filters at the time static pressures are measured.

3. Review Contractor-prepared shop drawings and Record drawings to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
4. Obtain approval from Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
5. 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 occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows.

1. Measure airflow of submain and branch ducts.
2. Adjust submain and branch duct volume dampers for specified airflow.
3. Re-measure each submain and branch duct after all have been adjusted.

C. Adjust air inlets and outlets for each space to indicated airflows.

1. Set airflow patterns of adjustable outlets for proper distribution without drafts.
2. Measure inlets and outlets airflow.

3. Adjust each inlet and outlet for specified airflow.
4. Re-measure each inlet and outlet after they have been adjusted.

D. Verify final system conditions.

1. Re-measure and confirm that minimum outdoor, return, and relief airflows are within design. Readjust to design if necessary.
2. Re-measure and confirm that total airflow is within design.
3. Re-measure all final fan operating data, speed, volts, amps, and static profile.
4. Mark all final settings.
5. Test system in economizer mode. Verify proper operation and adjust if necessary.
6. Measure and record all operating data.
7. Record final fan-performance data.

3.7 PROCEDURES FOR MOTORS

A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer's name, model number, and serial number.
2. Motor horsepower rating.
3. Motor rpm.
4. Phase and hertz.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter size and thermal-protection-element rating.
8. Service factor and frame size.

B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.8 PROCEDURES FOR AIR-COOLED CONDENSING UNITS

A. Verify proper rotation of fan(s).

B. Measure and record entering- and leaving-air temperatures.

C. Measure and record entering and leaving refrigerant pressures.

D. Measure and record operating data of compressor(s), fan(s), and motors.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each hydronic coil:

1. Entering- and leaving-water temperature.
2. Dry-bulb temperature of entering and leaving air.
3. Wet-bulb temperature of entering and leaving air for cooling coils.

4. Airflow.
5. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Air pressure drop.
5. Voltage and amperage input of each phase at full load.
6. Calculated kilowatt at full load.
7. Fuse or circuit-breaker rating for overload protection.

C. Measure, adjust, and record the following data for each refrigerant coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Entering and leaving refrigerant pressure and temperatures.

3.10 DUCT LEAKAGE TESTS

A. Witness the duct leakage testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.11 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.12 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.
2. Air Outlets and Inlets: Plus or minus 10 percent. If design value is less than 100 cfm, within 10 cfm.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.13 PROGRESS REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance-measuring and -balancing devices.

B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems. Report shall be submitted using NEBB or AABC recommended forms.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.
2. Manufacturers' test data.
3. Field test reports prepared by system and equipment installers.
4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Heating coil, dry-bulb conditions.
    e. Face and bypass damper settings at coils.
    f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    g. Settings for pressure controller(s).
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Apparatus-Coil Test Reports:

1. Coil Data:

    a. System identification.
    b. Location.
    c. Coil type.
    d. Number of rows.

e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Refrigerant expansion valve and refrigerant types.
i. Refrigerant suction pressure in psig.
j. Refrigerant suction temperature in deg F.

F. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btu/h.
h. Ignition type.
i. Burner-control types.
j. Motor horsepower and speed.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btu/h.

i. High-fire fuel input in Btu/h.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btu/h.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btu/h.

G. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Coil identification.
d. Capacity in Btu/h.
e. Number of stages.
f. Connected volts, phase, and hertz.
g. Rated amperage.
h. Airflow rate in cfm.
i. Face area in sq. ft..
j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

a. Heat output in Btu/h.
b. Airflow rate in cfm.
c. Air velocity in fpm.
d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave and amount of adjustments in inches.

2. Motor Data:

a. Motor make, and frame type and size.

b. Horsepower and speed.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave and amount of adjustments in inches.
g. Number, make, and size of belts.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan speed.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

a. System fan and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft..
g. Indicated airflow rate in cfm.
h. Indicated velocity in fpm.
i. Actual airflow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

J. Air-Terminal-Device Reports:

1. Unit Data:

a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft..

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Air velocity in fpm.

c. Preliminary airflow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final airflow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

K. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

3.15 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.

B. Architect/Engineer shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.16 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 13

DUCT INSULATION

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 insulating the following duct services:

1. Indoor, concealed supply and outdoor air.
2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in unconditioned space.
4. Indoor, exposed return located in unconditioned space.
5. Indoor, concealed oven exhaust.
6. Indoor, exposed oven exhaust.
7. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
8. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
9. Outdoor, concealed supply and return.
10. Outdoor, exposed supply and return.

B. Related Sections:

1. Section 23 07 16 "HVAC Equipment Insulation."
2. Section 23 07 19 "HVAC Piping Insulation."
3. Section 23 31 13 "Metal Ducts" for duct liners.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application of field-applied jackets.
4. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Duct Insulation Schedule, General," "Indoor Duct and Plenum Insulation Schedule," and "Aboveground, Outdoor Duct and Plenum Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type II and ASTM C1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation; Saint-Gobain North America.
    b. Johns Manville; a Berkshire Hathaway company.
    c. Knauf Insulation.
    d. Manson Insulation Inc.
    e. Owens Corning.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CertainTeed Corporation; Saint-Gobain North America.
    b. Johns Manville; a Berkshire Hathaway company.
    c. Knauf Insulation.
    d. Manson Insulation Inc.
    e. Owens Corning.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Eagle Bridges - Marathon Industries.
    c. Foster Brand; H. B. Fuller Construction Products.
    d. Mon-Eco Industries, Inc.

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

B. Vapor-Retarder Coating: Solvent based; suitable for indoor and outdoor use on below and above ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Knauf Insulation.
    d. Vimasco Corporation.

2. Equal to Foster 30-35.
3. Water-Vapor Permeance: Comply with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions.
4. Service Temperature Range: 0 to plus 180 deg F.
5. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
6. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Foster Brand; H. B. Fuller Construction Products.
   c. Vimasco Corporation.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Childers Brand; H. B. Fuller Construction Products.
   b. Eagle Bridges - Marathon Industries.
   c. Foster Brand; H. B. Fuller Construction Products.
   d. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with white aluminum-foil facing.

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. Polyguard Products, Inc.

2.8 SECUREMENTS

A. Bands:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ITW Insulation Systems; Illinois Tool Works, Inc.
b. RPR Products, Inc.

2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.
4) Nelson Stud Welding.

2. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.

3) Midwest Fasteners, Inc.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Copper- or zinc-coated, low-carbon steel, aluminum or stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum or stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) AGM Industries, Inc.
2) Gemco.
3) Midwest Fasteners, Inc.
4) Nelson Stud Welding.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

2.9 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

C. 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.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. 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 mastic.
3. 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.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Insulation joints shall be sealed with fiberglass mesh and vapor barrier mastic.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 INSTALLATION OF MINERAL-FIBER INSULATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. All seams shall be sealed with 4-inch wide fiberglass cloth tape embedded in Foster 30-35 white vapor barrier emulsion.
4. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Impale insulation over pins and attach speed washers.
    f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with fiberglass mesh tape matching insulation facing.
5. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions. All seams shall be sealed with 4-inch wide fiberglass cloth tape embedded in Foster 30-35 white vapor barrier emulsion.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to two times the insulation thickness, but not less than 3 inches.

6. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
7. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
8. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

    1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.

B. Insulate duct access panels and doors to achieve same fire rating as duct.

C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Section 07 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations for each duct system defined in the "Duct Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.9 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply, return and outdoor air.
2. Indoor, exposed supply, return and outdoor air.
3. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
5. Outdoor, supply, return and outdoor air.

B. Items Not Insulated:
1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.

5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.10 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air, return-air, outdoor-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density.

3.11 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a duct system, selection from materials listed is Contractor's option.

B. Supply-air, return-air, outdoor-air duct insulation shall be one of the following:

   1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. nominal density.

C. Exhaust duct insulation shall be one of the following:

   1. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.

D. Dust Collector duct insulation shall be one of the following:

   1. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.

3.12 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums, Concealed:

   1. None.

3.13 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Ducts and Plenums:
   Painted aluminum, stucco embossed: 0.024 inch thick.

END OF SECTION

SECTION 23 07 19

HVAC PIPING INSULATION

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 insulation for HVAC piping systems.

B. Related Requirements:

1. Section 23 07 13 "Duct Insulation" for duct insulation.
2. Section 23 07 16 "HVAC Equipment Insulation" for equipment insulation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation

materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

A. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.

1. Preformed Pipe Insulation without Jacket: Type II, Class 1, without jacket.
2. Preformed Pipe Insulation with Jacket: Type II, Class 2, with factory-applied ASJ jacket.
3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

B. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534/C534M, Type I for tubular materials, Type II for sheet materials.

C. Mineral-Fiber, Preformed Pipe: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547.
1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
2. 850 deg F (454 deg C).
3. Factory fabricate shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
a.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
1. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less as tested in accordance with ASTM E84.
2. Wet Flash Point: Below 0 deg F.
3. Service Temperature Range: 40 to 200 deg F.
4. Color: Black.

2.3 MASTICS AND COATINGS

A. Materials shall be compatible with insulation materials, jackets, and substrates.

1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.

B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Comply with MIL-PRF-19565C, Type II, for permeance requirements.
4. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: 0 to 180 deg F.
3. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
2. Service Temperature Range: Minus 50 to plus 220 deg F.
3. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Color: White .

2.4 LAGGING ADHESIVES

A. Adhesives shall comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.

1. Verify adhesive is as recommended by insulation manufacturer and has a VOC content of 50 g/L or less.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.5 SEALANTS

A. Materials shall be as recommended by the insulation manufacturer and shall be compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:
1. Permanently flexible, elastomeric sealant.

a. Service Temperature Range: Minus 150 to plus 250 deg F.
b. Color: White or gray.

C. FSK and Metal Jacket Flashing Sealants:
1. Fire- and water-resistant, flexible, elastomeric sealant.
2. Service Temperature Range: Minus 40 to plus 250 deg F.
3. Color: Aluminum.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C1136, Type I, unless otherwise indicated.

B. Metal Jacket:
1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Sheet and roll stock ready for shop or field sizing.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.

d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
e. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

C. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with stucco-embossed aluminum-foil facing.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:
1. Stainless Steel: ASTM A240/A240M, Type 304; 0.015 inch thick, 1/2 inch wide with wing seal.
2. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.
3. Springs: Twin spring set constructed of stainless steel, with ends flat and slotted to accept metal bands. Spring size is determined by manufacturer for application.

B. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.

C. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. 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.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. 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 attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. 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.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 25 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape

insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as that of pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as that of straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.10 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless steel jackets.

3.11 FIELD QUALITY CONTROL

A. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

B. All insulation applications will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size shall comply with schedules in this Section or with requirements of authorities having jurisdiction, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
1. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Flexible Elastomeric: 3/4 inch thick.

B. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 1 inch thick.

C. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 1 inch thick.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
a. Flexible Elastomeric: 1-1/2 inches thick.

B. Refrigerant Liquid Piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1-1/2 inches thick.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:
1. Aluminum, Smooth: 0.024 inch thick.

D. Piping, Exposed:
   1. Painted Aluminum, Corrugated with Z-Shaped Locking Seam: 0.024 inch thick.

END OF SECTION

SECTION 23 09 23.16

GAS INSTRUMENTS

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 the Following Gas Instruments:

1. Multi gas sensors and transmitters.
2. Multipoint carbon-monoxide monitoring system.

B. Related Requirements:

1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 23 09 23.16.

1.3 DEFINITIONS

A. NDIR: Nondispersive infrared.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
2. Installation instructions, including factor affecting performance.
3. Product description with complete technical data, performance curves, product specification sheets.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include diagrams for power, signal, and control wiring.
3. Number-coded identification system for unique identification of wiring, cable, and tubing ends.

C. Samples: For each exposed product installed in finished space.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which wall-mounted instruments located in finished space are shown and coordinated with each other, showing relationship to light switches, fire alarm devices, and other installed devices using input from installers of the items involved.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gas instruments to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period. Contractor shall guarantee all installed equipment, material, and work against any defects in material or workmanship and shall satisfactorily correct, at no cost to the State,

any such defect that may become apparent within a period of one year after completion of the installation.

PART 2 - PRODUCTS

2.1 MULTIPOINT CARBON-MONOXIDE, METHANE, PROPANE AND NITROGEN DIOXIDE MONITORING SYSTEM

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. Armstrong Monitoring Corporation
2. BW Technologies
3. Critical Environmental Technologies
4. Enmet Corporation
5. Honeywell
6. Thermo Gas Tech
7. Rel-Tek Corporation.

B. Description:

1. Wall mounted gas monitoring system for carbon monoxide, nitrogen dioxide, methane, and propane.
2. Each sampling point shall monitor any variation in the gas concentration level.
3. Each sampling point shall be individually piped to the monitoring system.
4. Provide each sampling point with a 0.3-micron filter.
5. Each sampling point shall be an alarm point.
6. A dual-head diaphragm pump shall draw an air sample through piping system and through a microprocessor-controlled sequencer feeding an analyzer with a new sample every 15 seconds.
7. Sample time shall be adjustable in 1 second increments from zero to 60 minutes.
8. Span and zero calibration gas shall be automatically initiated by the microprocessor. System shall also provide manual initiation of span and zero calibration gas.
9. Analyzer output shall be corrected by the microprocessor.
10. System shall operate on 120-V ac, single-phase, 60-Hz power.
11. Controller shall handle number of remote transmitters and relays indicated in the drawings and shall be able to detect multiple gases including combustible gases.
12. Final adjustment; calibration, testing, and startup of the system shall be performed by a trained representative of manufacturer.
13. System shall include visual and audible alarms.

C. Sensor:

1. Sensor shall be electrochemical cell for carbon monoxide and nitrogen dioxide and catalytic for propane and methane.

D. Analyzer:

1. Analyzer shall operate using principle of nondispersive infrared absorption.
2. Sampling response time shall be within 10 seconds.
3. Zero drift and span drift shall be less than 1 percent of full scale within a 24-hour period.
4. Repeatability shall be within 1 percent of full scale.
5. Accuracy shall be within 3 percent of full scale at 122 deg F.
6. Calibration range shall be zero to 500 ppm.
7. Digital display on analyzer face with scale shall be in ppm.
8. Temperature shall be compensated from -40 to 122 deg F ambient temperature.

E. Control and Display:

1. Each sample shall send a 4-20 mA output signal proportional to the highest concentration.
2. Alphanumeric visual display of current analyzer concentration reading shall be in ppm or another industry-accepted measurement.
3. Visual indication for sample analyzing, sample high-concentration alarm, analyzer malfunction, and calibration.
4. Any number and configuration of sample points shall be capable of being bypassed.
5. Each sample point shall be capable of being manually sampled through an override feature.
6. System parameters shall be stored in nonvolatile memory.
7. Provide at least an eight-hour battery backup of current alarm status. Battery shall be rechargeable.
8. Monitoring system shall activate mechanical ventilation system (including motorized dampers) and deactivate radiant heaters in the space upon sensing of any gas at or above Alarm A levels.

F. Enclosure:

1. NEMA 250, Type 1 or Type 12.
2. Hinged and locking door, full size of face.
3. House all system components. Multiple adjoining enclosures are acceptable if joined to a common support structure.

G. Audible Alarm:

1. Provides an audible horn when an alarm condition occurs.
2. Horn shall be rated for 85 dB with selectable output tones.

H. Detection Ranges and Alarm Levels:

1. Carbon monoxide (CO):
   a. Resolution: 1 ppm
   b. Range: 0-250 ppm
   c. Alarm A: 25 ppm
   d. Alarm B: 100 ppm
   e. Alarm C: 225 ppm

2. Nitrogen dioxide (NO2):
   a. Resolution: 0.1 ppm

b. Range: 0-10 ppm
c. Alarm A: 0.7 ppm
d. Alarm B: 2 ppm
e. Alarm C: 9 ppm

3. Propane (C3H8):
   a. Resolution: 0.5% LEL
   b. Range: 0-100% LEL
   c. Alarm A: 25% LEL
   d. Alarm B: 50% LEL
   e. Alarm C: 90% LEL

4. Methane (CH4):
   a. Resolution: 0.5% LEL
   b. Range: 0-100% LEL
   c. Alarm A: 25% LEL
   d. Alarm B: 50% LEL
   e. Alarm C: 90% LEL

I. Calibration Equipment:

1. Provide equipment necessary to automatically and manually calibrate the system, including, but not be limited to, the following:

   a. Regular assembly.
   b. Zero cap.
   c. Calibration cap.
   d. Two cylinders filled with calibration gas.
   e. Instruction book.
   f. Carrying case.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to seismic loads.

D. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by using excessive force or oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

1. When conduit is in contact with a corrosive environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment.
2. Where instruments are located in a corrosive environment and are not corrosive resistant from manufacturer, field install products in a NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.3 ELECTRICAL POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.4 INSTRUMENTS, GENERAL INSTALLATION REQUIREMENTS

A. Mounting Location:

1. Install transmitters for gas associated with individual air-handling units and associated connected ductwork and piping near air-handlings units co-located in air-handling unit

system control panel, to provide service personnel a single and convenient location for inspection and service.

2. Install gas switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
3. Mount switches and transmitters not required to be mounted within system control panels on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Mounting Height:

1. Mount instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code, state, and federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.

    a. Make every effort to mount at 60 inches.

C. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated, using neoprene gaskets or grommets.

3.5 MULTIPOINT GAS MONITORING SYSTEM

A. Install sample points in monitored area to provide accurate measurement of gas concentration.

B. Install exposed sampling points with a finished appearance consistent with other materials in space. Submit proposed products to be installed for review and approval.

C. Individually install each sample point to the carbon-monoxide monitoring system.

D. Install tubing in a minimum size of NPS 3/8.

E. Use compression fittings at connections to equipment.

F. Bottom of monitor panel shall be mounted on wall 48” above floor.

G. Sensors shall be mounted on wall at the following elevations:
1. Propane: 6 inches above floor
2. Methane: 12 inches from highest point of room
3. Nitrogen Dioxide: 60 inches above floor
4. Carbon Monoxide: 60 inches above floor

H. Strobe Warning light and alarm annunciator shall be installed on a wall 10 feet above floor. All wiring shall be run in conduit.

I. If not indicated on Drawings, locate carbon-monoxide monitoring system in a secured and serviceable location accessible to authorized personnel.

J. Support gas monitoring system from floor or wall. Support floor-mounted systems using a structural channel frame. Provide mounting brackets.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification on face.

3.7 CHECKOUT PROCEDURES

A. Check out installed products before continuity tests, leak tests, and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

3.8 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, perform a three-point calibration test for both linearity and accuracy.
4. Equipment and procedures used for calibration shall comply with instrument manufacturer's written recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have an accuracy of at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If, after calibration, indicated performance cannot be achieved, replace out-of-tolerance instruments.

9. Comply with field-testing requirements and procedures in ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Meters: Check sensors at zero, 50, and 100 percent of Project design values.

E. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

F. Switches: Calibrate switches to make or break contact at set points indicated.

G. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.9 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include semiannual preventive maintenance, repair or replacement of worn or defective components, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

B. Coordinate gas instrument demonstration video with operation and maintenance manuals and classroom instruction for use by Owner in operating, maintaining, and troubleshooting.

C. Record videos on DVD disks.

D. Owner shall have right to make additional copies of video for internal use without paying royalties.

END OF SECTION

SECTION 231113

FACILITY FUEL-OIL PIPING

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. Fuel-oil pipes, tubes, and fittings.
2. Double-containment pipe and fittings.
3. Piping specialties.
4. Joining materials.
5. Specialty valves.
6. Mechanical leak-detection valves.
7. Leak-detection and monitoring system.
8. Labels and identification.

1.3 DEFINITIONS

A. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

B. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and dimensions of individual components and profiles.
2. Include, where applicable, rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

3. For valves, include pressure rating, capacity, settings, and electrical connection data of selected models.

B. Shop Drawings: For fuel-oil piping.

1. Include plans, elevations sections, hangers, and supports for multiple pipes.
2. Include details of location of anchors, alignment guides, and expansion joints and loops.
3. Scale: 1/4 inch per foot.

C. Delegated-Design Submittal: For fuel-oil piping indicated to comply with performance requirements and design criteria.

1. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Detail fabrication and assembly of anchors and seismic restraints.
3. Design Calculations: Calculate requirements for selecting seismic restraints.
4. Detail fabrication and assembly of pipe anchors, hangers, supports for multiple pipes, and attachments of the same to building structure.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Plans and details, drawn to scale, on which fuel-oil piping is shown and coordinated with other installations, using input from installers of the items involved.
2. Site Survey: Plans, drawn to scale, on which fuel-oil piping and tanks are shown and coordinated with other services and utilities.

B. Brazing certificates.

C. Welding certificates.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-oil equipment and accessories to include in emergency, operation, and maintenance manuals.

1.7 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.

1.8 QUALITY ASSURANCE

A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

B. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Pipe Welding Qualifications: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Lift and support fuel-oil storage tanks only at designated lifting or supporting points, as shown on Shop Drawings. Do not move or lift tanks unless empty.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.

D. Store PE pipes and valves protected from direct sunlight.

1.10 FIELD CONDITIONS

A. Interruption of Existing Fuel-Oil Service: Do not interrupt fuel-oil service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fuel-oil supply according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of fuel-oil service.
2. Do not proceed with interruption of fuel-oil service without Construction Manager's written permission.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of flexible, double-containment piping and related equipment that fail in materials or workmanship within specified warranty period.

1. Failures due to defective materials or workmanship for materials including piping, dispenser sumps, water-tight sump entry boots, terminations, and other end fittings.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.

C. Fuel-Oil Valves: Comply with UL 842 and have service mark initials "WOG" permanently marked on valve body.

D. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil piping.

2.2 PERFORMANCE REQUIREMENTS

A. Maximum Operating-Pressure Ratings: 3-psig fuel-oil supply pressure at oil-fired appliances.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design restraints and anchors and multiple pipe supports and hangers for fuel-oil piping.

2.3 FUEL-OIL PIPES, TUBES, AND FITTINGS

A. See "Outdoor Piping Installation" and "Indoor Piping Installation" articles for where pipes, tubes, fittings, and joining materials are applied in various services.

B. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M, for butt and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded up to 2” and butt welding for larger sizes.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
    e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

2.4 PIPING SPECIALTIES

A. Metallic Flexible Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. American Flexible Hose Co., Inc.
   b. Flexicraft Industries.
   c. FLEX-ING, Inc.
   d. Metraflex Company (The).
   e. Tru-Flex Metal Hose Corp.

2. Listed and labeled for aboveground and underground applications by an NRTL acceptable to authorities having jurisdiction.
3. Stainless-steel bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
4. Minimum Operating Pressure: 150 psig.
5. End Connections: Socket, flanged, or threaded end to match connected piping.
6. Maximum Length: 30 inches
7. Swivel end, 50-psig maximum operating pressure.
8. Factory-furnished anode for connection to cathodic protection.

B. Basket Strainers:

1. Body: ASTM A126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 80-mesh startup strainer and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

2.5 JOINING MATERIALS

A. Joint Compound and Tape for Threaded Joints: Suitable for fuel oil.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

D. Bonding Adhesive for RTRP and RTRF: As recommended by piping and fitting manufacturer.

2.6 SPECIALTY VALVES

A. Pressure Relief Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Anderson Greenwood; Pentair, Ltd.
    b. Fulflo Specialties, Inc.
    c. OPW Engineered Systems; OPW Fluid Transfer Group; a Dover company.
    d. Webster Fuel Pumps & Valves; a division of Capital City Tool, Inc.
2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
3. Body: Brass, bronze, or cast steel.
4. Springs: Stainless steel, interchangeable.
5. Seat and Seal: Nitrile rubber.
6. Orifice: Stainless steel, interchangeable.
7. Factory-Applied Finish: Baked enamel.
8. Maximum Inlet Pressure: 150 psig.
9. Relief Pressure Setting: 60 psig.

B. Oil Safety Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Anderson Greenwood; Pentair, Ltd.
    b. Fulflo Specialties, Inc.
    c. OPW Engineered Systems; OPW Fluid Transfer Group; a Dover company.
    d. Webster Fuel Pumps & Valves; a division of Capital City Tool, Inc.
2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
3. Body: Brass, bronze, or cast steel.
4. Springs: Stainless steel.
5. Seat and Diaphragm: Nitrile rubber.
6. Orifice: Stainless steel, interchangeable.
7. Factory-Applied Finish: Baked enamel.
8. Manual override port.
9. Maximum Inlet Pressure: 60 psig.
10. Maximum Outlet Pressure: 3 psig.

C. Emergency Shutoff Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. EMCO Wheaton.
   b. Franklin Fueling Systems.
   c. OPW Engineered Systems; OPW Fluid Transfer Group; a Dover company.

2. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.
3. Double poppet valve.
4. Body: ASTM A126, cast iron.
5. Disk: FPM.
6. Poppet Spring: Stainless steel.
7. Stem: Plated brass.
8. O-Ring: FPM.
9. Packing Nut: PTFE-coated brass.
10. Fusible link to close valve at 165 deg F.
11. Thermal relief to vent line pressure buildup due to fire.
12. Air test port.
13. Maximum Operating Pressure: 0.5 psig.

2.7 MECHANICAL LEAK-DETECTION VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Franklin Fueling Systems.
2. Red Jacket Pumps.

B. Listed and labeled for fuel-oil service by an NRTL acceptable to authorities having jurisdiction.

C. Body: ASTM A126, cast iron.

D. O-Rings: Elastomeric compatible with fuel oil.

E. Piston and Stem Seals: PTFE.

F. Stem and Spring: Stainless steel.

G. Piston Cylinder: Burnished brass.

H. Indicated Leak Rate: Maximum 3 gph at 10 psig.

I. Leak Indication: Reduced flow.

2.8 LEAK-DETECTION AND MONITORING SYSTEM

A. Cable and Sensor System: Comply with UL 1238.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Caldwell Systems Corporation.
   b. Containment Solutions, Inc.
   c. Franklin Fueling Systems.
   d. Highland Tank & Manufacturing Company, Inc.
   e. Pentair Thermal Management.

2. Calibrated leak-detection and monitoring system with probes and other sensors and remote alarm panel for fuel-oil piping.
3. Include fittings and devices required for testing.

2.9 LABELS AND IDENTIFICATION

A. Detectable Warning Tape: Acid- and alkali-resistant PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas for compliance with requirements for installation tolerances and other conditions affecting performance of fuel-oil piping.

B. Examine installation of fuel-burning equipment and fuel-handling and storage equipment to verify actual locations of piping connections before installing fuel-oil piping.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 PREPARATION

A. Close equipment shutoff valves before turning off fuel oil to premises or piping section.

B. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.4 INSTALLATION OF OUTDOOR PIPING

A. Install Underground Fuel-Oil Piping Buried:

1. Under Compacted Backfill: 24” below finished grade.
2. Under Asphalt 2 Inches Thick: 8 inches below bottom of asphalt.
3. Under 4 Inches of Reinforced Concrete in Areas Subject to Vehicle Traffic: 4 inches below bottom of concrete.
4. If fuel-oil piping is installed with less than 12 inches of cover to finished grade, install in containment piping.
5. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

B. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining, to cover, seal, and protect joints.
2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer. Review protective coating damage with Architect prior to repair.
3. Replace pipe having damaged PE coating with new pipe.

C. Install double-containment, fuel-oil pipe at a minimum slope of 1 percent downward toward fuel-oil storage tank sump.

D. Install vent pipe at a minimum slope of 2 percent downward toward fuel-oil storage tank sump.

E. Assemble and install entry boots for pipe penetrations through sump sidewalls for liquid-tight joints.

F. Install metal pipes and tubes, fittings, valves, and flexible connectors at piping connections to AST and UST.

G. Install fittings for changes in direction in rigid pipe.

H. Install system components with pressure rating equal to or greater than system operating pressure.

3.5 INSTALLATION OF INDOOR PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction to allow for mechanical installations.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings at a height that allows sufficient space for ceiling panel removal.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Comply with requirements for equipment specifications for roughing-in requirements.

I. Conceal pipe installations in walls, pipe spaces, or utility spaces; above ceilings; below grade or floors; and in floor channels unless indicated to be exposed to view.

J. Prohibited Locations:

1. Do not install fuel-oil piping in or through HVAC ducts and plenums, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
2. Do not install fuel-oil piping in solid walls or partitions.

K. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

L. Connect branch piping from top or side of horizontal piping.

M. Install unions in pipes NPS 2 and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.

N. Do not use fuel-oil piping as grounding electrode.

O. Install sleeves and sleeve seals for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.6 INSTALLATION OF VALVES

A. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.

B. Install valves in accessible locations.

C. Install oil safety valves at inlet of each oil-fired appliance.

D. Install pressure relief valves in distribution piping between the supply and return lines.

E. Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping. Comply with requirements in Section 230523.12 "Ball Valves for HVAC Piping."

F. Install manual air vents at high points in fuel-oil piping.

G. Install emergency shutoff valves at dispensers.

3.7 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Bevel plain ends of steel pipe.
2. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tubing" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness for service application. Install gasket concentrically positioned.

G. Flared Joints: Comply with SAE J513. Tighten finger tight then use wrench according to fitting manufacturer's written instructions. Do not overtighten.

H. Fiberglass-Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.8 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

B. Comply with requirements for hangers, supports, and anchor devices specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

C. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping within 12 inches of each fitting and coupling.

E. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.9 INSTALLATION OF LEAK-DETECTION AND MONITORING SYSTEM

A. Install leak-detection and monitoring system. Install alarm panel inside building where indicated.

B. Double-Containment, Fuel-Oil Piping: Install leak-detection sensor probes at low points in piping.

3.10 CONNECTIONS

A. Where installing piping adjacent to equipment, allow space for service and maintenance.

B. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.

C. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.

D. Connect piping to equipment with shutoff valve and union. Install union between valve and equipment.

E. Install flexible piping connectors at final connection to burners or oil-fired appliances.

3.11 LABELING AND IDENTIFYING

A. Nameplates, pipe identification, valve tags, and signs are specified in Section 230553 "Identification for HVAC Piping and Equipment."

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on or near each service regulator, service meter, and earthquake valve.

1. Text: In addition to identifying unit, distinguish between multiple units; inform operator of operational requirements; indicate safety and emergency precautions; and warn of hazards and improper operations.

C. Install detectable warning tape directly above fuel-oil piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs. Terminate tracer wire in an accessible area, and identify as "tracer wire" for future use with plastic-laminate sign.

1. Piping: Over underground fuel-oil distribution piping.

3.12 FIELD QUALITY CONTROL

A. Pressure Test Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system:

1. Fuel-Oil Distribution Piping: Minimum 5 psig for minimum 30 minutes.
2. Fuel-Oil, Double-Containment Piping:

a. Carrier Pipe: Minimum 5 psig for minimum 30 minutes.
b. Containment Conduit: Minimum 5 psig for minimum 60 minutes.

3. Suction Piping: Minimum 20-in. Hg for minimum 30 minutes.
4. Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 10 psig.

B. Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.

C. Test leak-detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.

D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Bleed air from fuel-oil piping using manual air vents.

F. Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.13 OUTDOOR PIPING SCHEDULE

A. Underground Fuel-Oil Piping: Flexible, double-containment piping. Size indicated is carrier-pipe size.

B. Underground fuel-oil-tank fill and vent piping shall be one of the following:

1. NPS 2 and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints. Coat pipe and fittings with protective coating for steel piping.
2. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints. Coat pipe and fittings with protective coating for steel piping.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

D. Aboveground fuel-oil piping shall be one of the following:

1. NPS 2 and Smaller: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
2. NPS 2-1/2 and Larger: Steel pipe, steel welding fittings, and welded joints.

3.14 INDOOR PIPING SCHEDULE

A. Aboveground fuel-oil piping shall be one of the following:

1. NPS 1/2 and Smaller: Annealed-temper copper pipe, wrought copper fittings, and brazed or flared joints.
2. NPS 5/8 to NPS 2: Steel pipe, steel or malleable-iron threaded fittings, and threaded joints.
3. NPS 2-1/2 and Larger: Steel pipe, steel fittings, and welded or flanged joints.

3.15 SHUTOFF VALVE SCHEDULE

A. Valves for aboveground distribution piping NPS 2 and smaller shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

B. Distribution piping valves for pipe NPS 2-1/2 and larger shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze, nonlubricated plug valve.

C. Valves in branch piping for single appliance shall be one of the following:

1. One-piece, bronze ball valve with bronze trim.
2. Two-piece, full-port, bronze ball valves with bronze trim.

END OF SECTION 231113

SECTION 23 11 23

FACILITY NATURAL-GAS PIPING

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. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.

1.3 DEFINITIONS

A. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Forpressure regulators to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

E. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

F. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

C. Protect stored PE pipes and valves from direct sunlight.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Section 08 31 13 "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.
3. Minimum Operating Pressure of Service Meter: 5 psig.

B. Natural-Gas System Pressure within Buildings: More than 2 psig but not more than 5 psig.

2.2 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
2. Wrought-Steel Welding Fittings: ASTM A234/A234M for butt welding and socket welding.
3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

    a. Material Group: 1.1.
    b. End Connections: Threaded or butt welding to match pipe.
    c. Lapped Face: Not permitted underground.
    d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

5. Protective Coating for Underground Piping: Factory-applied, three-layer coating of epoxy, adhesive, and PE.

    a. Joint Cover Kits: Epoxy paint, adhesive, and heat-shrink PE sleeves.

B. PE Pipe: ASTM D2513, SDR 11 safety yellow colored.

1. PE Fittings: ASTM D2683, socket-fusion type or ASTM D3261, butt-fusion type with dimensions matching PE pipe.
2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D2513, SDR 11; and steel pipe complying with ASTM A53/A53M, black steel, Schedule 40, Type E or S, Grade B.
3. Anodeless Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet.
    b. Casing: Steel pipe complying with ASTM A53/A53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Vent casing aboveground.
    c. Aboveground Portion: PE transition fitting.
    d. Outlet shall be threaded or flanged or suitable for welded connection.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

4. Transition Service-Line Risers: Factory fabricated and leak tested.

    a. Underground Portion: PE pipe complying with ASTM D2513, SDR 11 inlet connected to steel pipe complying with ASTM A53/A53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    b. Outlet shall be threaded or flanged or suitable for welded connection.
    c. Bridging sleeve over mechanical coupling.
    d. Factory-connected anode.
    e. Tracer wire connection.
    f. Ultraviolet shield.
    g. Stake supports with factory finish to match steel pipe casing or carrier pipe.

5. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
    a. Steel flanges and tube with epoxy finish.
    b. Buna-nitrile seals.
    c. Steel bolts, washers, and nuts.
    d. Factory-installed anode for steel-body couplings installed underground.

2.3 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches

B. Y-Pattern Strainers:

1. Body: ASTM A126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: [**40**] [**60**]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.5 MANUAL GAS SHUTOFF VALVES

A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.

B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.
2. Threaded Ends: Comply with ASME B1.20.1.
3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig.
2. Flanged Ends: Comply with ASME B16.5 for steel flanges.

3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Body: Bronze, complying with ASTM B584.
2. Ball: Chrome-plated bronze.
3. Stem: Bronze; blowout proof.
4. Seats: Reinforced TFE; blowout proof.
5. Packing: Threaded-body packnut design with adjustable-stem packing.
6. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
7. CWP Rating: 600 psig.
8. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
9. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. Bronze Plug Valves: MSS SP-78.

1. Body: Bronze, complying with ASTM B584.
2. Plug: Bronze.
3. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
4. Operator: Square head or lug type with tamperproof feature where indicated.
5. Pressure Class: 125 psig.
6. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
7. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.6 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Body and Diaphragm Case: Cast iron or die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
5. Orifice: Aluminum; interchangeable.

6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
8. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
9. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
10. Maximum Inlet Pressure: 5 psig.

C. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Body and Diaphragm Case: Die-cast aluminum.
2. Springs: Zinc-plated steel; interchangeable.
3. Diaphragm Plate: Zinc-plated steel.
4. Seat Disc: Nitrile rubber.
5. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
6. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
7. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
8. Maximum Inlet Pressure: 5 psig.

2.7 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.
c. End Connections: Solder-joint copper alloy and threaded ferrous.

2.8 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Section 31 20 00 "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

2. All underground piping shall be bedded in a minimum of 4 inches of clean sand, above, below and on all sides.

3. If natural-gas piping is installed under paved areas, install it in containment conduit.

C. Install underground, PE, natural-gas piping according to ASTM D2774.

D. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Replace pipe having damaged PE coating with new pipe.

E. Install fittings for changes in direction and branch connections.

F. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section 23 05 19 "Meters and Gages for HVAC Piping."

3.4 INDOOR PIPING INSTALLATION

A. Comply with NFPA 54 for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.

K. Verify final equipment locations for roughing-in.

L. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

M. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

N. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

O. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

P. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.

1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.

    a. Exception: Tubing passing through partitions or walls does not require striker barriers.

5. Prohibited Locations:

    a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    b. Do not install natural-gas piping in solid walls or partitions.

Q. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

R. Connect branch piping from top or side of horizontal piping.

S. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

T. Do not use natural-gas piping as grounding electrode.

U. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

V. Install pressure gage upstream and downstream] from each line regulator. Pressure gages are specified in Section 23 05 19 "Meters and Gages for HVAC Piping."

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

Y. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.5 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

C. Install anode for metallic valves in underground PE piping.

3.6 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean using sharp dies.
3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.
3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.

F. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

1. Plain-End Pipe and Fittings: Use butt fusion.
2. Plain-End Pipe and Socket Fittings: Use socket fusion.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Install hangers for steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Install hangers for corrugated stainless-steel tubing, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

D. Support horizontal piping within 12 inches of each fitting.

E. Support vertical runs of steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

F. Support vertical runs of corrugated stainless-steel tubing to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

A. Connect to utility's gas main according to utility's procedures and requirements.

B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.

C. Install piping adjacent to appliances to allow service and maintenance of appliances.

D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

F. Install dirt legs and flexible gas hose at all connections to appliances and points of use.

3.9 LABELING AND IDENTIFYING

A. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.10 PAINTING

A. Comply with requirements in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting" for painting interior and exterior natural-gas piping.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Exterior alkyd enamel.
d. Color: Yellow .

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.11 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.12 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

3.13 OUTDOOR PIPING SCHEDULE

A. Underground natural-gas piping shall be one of the following:

1. PE pipe and fittings joined by heat fusion, service-line risers with tracer wire terminated in an accessible location.
2. Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

B. Aboveground natural-gas piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints for piping 2” and smaller.

2. Steel pipe with malleable-iron fittings and welded joints for piping 2-1/2” and larger.

C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

D. Galvanized steel and copper piping and fittings for natural-gas piping is PROHIBITED.

3.14 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 5 PSIG

A. Aboveground, distribution piping shall be the following:

1. Steel pipe with malleable-iron fittings and threaded joints for piping 2” and smaller.

2. Steel pipe with malleable-iron fittings and welded joints for piping 2-1/2” and larger.

3.15 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

C. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

D. Valves in branch piping for single appliance shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

END OF SECTION

SECTION 23 23 00

REFRIGERANT PIPING

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. Copper tube and fittings.
2. Valves and specialties.
3. Refrigerants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve, refrigerant piping, and piping specialty.

1. Include pressure drop, based on manufacturer's test data, for the following:

a. Thermostatic expansion valves.
b. Solenoid valves.
c. Hot-gas bypass valves.
d. Filter dryers.
e. Strainers.
f. Pressure-regulating valves.

B. Shop Drawings:

1. Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes; flow capacities; valve arrangements and locations; slopes of horizontal runs; oil traps; double risers; wall and floor penetrations; and equipment connection details.
2. Show piping size and piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.
3. Show interface and spatial relationships between piping and equipment.
4. Shop Drawing Scale: 1/4 inch equals 1 foot.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to 2010 ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

D. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

E. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

F. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

1.7 PRODUCT STORAGE AND HANDLING

A. Store piping with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-134a:

1. Suction Lines for Air-Conditioning Applications: 115 psig.
2. Suction Lines for Heat-Pump Applications: 225 psig.
3. Hot-Gas and Liquid Lines: 225 psig.

B. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

C. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

2.2 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L.

B. Wrought-Copper Fittings, Solder-Joint: ASME B16.22.

C. Wrought-Copper Fittings, Brazed-Joint: ASME B16.50.

D. Wrought-Copper Unions: ASME B16.22.

E. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

F. Brazing Filler Metals: AWS A5.8/A5.8M.

G. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.3 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. End Connections: Socket, union, threaded, or flanged.
6. Maximum Opening Pressure: 0.50 psig.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Refrigerant Locking Caps:

1. Description: Locking-type, tamper-resistant, threaded caps to protect refrigerant charging ports from unauthorized refrigerant access and leakage.
2. Material: Brass, with protective shroud or sleeve.
3. Refrigerant Identification: Universal design.
4. Special Tool: For installing and unlocking.

F. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory (NRTL).

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.

G. Safety Relief Valves: Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

H. Thermostatic Expansion Valves: Comply with AHRI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: [**40 deg F**] <**Insert temperature**>.
6. Superheat: [**Adjustable**] [**Nonadjustable**].
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: [**700 psig**] [**450 psig**] <**Insert value**>.

I. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.

6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated [**alumina**] [**charcoal**].
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

L. Permanent Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated [**alumina**] [**charcoal**].
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.
10. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
11. Comply with UL 207; listed and labeled by an NRTL.
12. Body: Welded steel with corrosion-resistant coating.
13. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
14. End Connections: Socket or threaded.
15. Working Pressure Rating: 500 psig.
16. Maximum Operating Temperature: 275 deg F.

M. Liquid Accumulators: Comply with AHRI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.
4. Maximum Operating Temperature: 275 deg F.

2.4 REFRIGERANTS

A. ASHRAE 34, R-134a: Tetrafluoroethane.

B. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-134a, R-407C, R-410A

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

B. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed or soldered joints.

C. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications:
   1. Copper, Type L, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves for gauge taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

C. Except as otherwise indicated, install diaphragm packless or packed-angle valves on inlet and outlet side of filter dryers.

D. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

E. Install thermostatic expansion valves as close as possible to distributors on evaporators.

   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install safety relief valves where required by 2010 ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for the device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

I. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

J. Install flexible connectors at compressors.

K. Provide refrigerant locking caps on refrigerant charging ports that are located outdoors unless otherwise protected from unauthorized access by a means acceptable to the authority having jurisdiction.

3.3 INSTALLATION OF PIPING, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 08 31 13 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

L. Install refrigerant piping in protective conduit where installed belowground.

M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves according to Section 23 05 53 "Identification for HVAC Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen) during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for seismic restraints in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

B. Comply with Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

C. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

D. Install hangers for copper tubing, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

E. Support horizontal piping within 12 inches of each fitting.

F. Support vertical runs of copper tubing to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

B. Prepare test and inspection reports.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13

METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round ducts and fittings.
4. Double-wall round ducts and fittings.
5. Sheet metal materials.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 33 00 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

A. OSHPD: Office of Statewide Health Planning and Development (State of California).

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.
3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top and bottom of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: A single set of plans or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Welding certificates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Startup."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include insulation or duct wall thickness.

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

B. General Fabrication Requirements for duct collection exhaust: Comply with SMACNA “Round Industrial Duct Construction Standards”

C. Transverse Joints: Fabricate joints in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.

D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Rectangular Ducts: Fabricate ducts with indicated dimensions for clear internal dimensions of the inner duct.

B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.
2. For equipment requiring stainless steel duct, provide stainless steel type 304 in 2B finish.

C. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
2. For ducts with longest side 36 inches or greater, use flange joint connector Type T-22, T-24, T-24A, T-25a, or T-25b. Factory-fabricated flanged duct connection system may be used if submitted and approved by engineer of record.
3. Where specified for specific applications, all joints shall be welded.

D. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Where specified for specific applications, all joints shall be welded.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

F. Inner Duct:

1. Construct ducts of galvanized sheet steel unless otherwise indicated. Minimum 24-gauge solid galvanized sheet steel.
2. For equipment requiring stainless steel duct, provide stainless steel type 304 in 2B finish.

2.4 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

1. Construct ducts of galvanized sheet steel unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.5 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

1. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.

    a. Construct ducts of galvanized sheet steel unless otherwise indicated.
    b. For equipment requiring stainless steel duct, provide stainless steel type 304 in 2B finish.

2. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

3. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

    a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
    b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

4. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Inner Duct:

1. Construct ducts of galvanized sheet steel unless otherwise indicated. Minimum 24-gauge solid galvanized sheet steel.
2. For equipment requiring stainless steel duct, provide stainless steel type 304 in 2B finish.

C. Interstitial Insulation: Fibrous-glass liner complying with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
3. Coat insulation with antimicrobial coating.
4. Cover insulation with polyester film complying with UL 181, Class 1.

2.6 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.
3. Minimum 24-gauge.
4. 26-gauge is not acceptable for any ducts.

C. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304 or 316, as indicated in "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in "Duct Schedule" Article.

2.7 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested in accordance with UL 723; certified by an NRTL.

B. Solvent based duct sealants shall be prohibited.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10 inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Verify sealant has a VOC content of 420 g/L or less.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.8 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Galvanized-steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A492.

F. Steel Cable End Connections: Galvanized-steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. All material components on galvanized sheet metal ducts shall be galvanized materials such as angle stiffeners, trapeze hangers, rods, straps, etc.

I. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and coordination drawings.

B. Install ducts in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install ducts in maximum practical lengths with fewest possible joints.

D. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

E. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

I. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

J. Install fire, combination fire/smoke, and smoke dampers where indicated on Drawings and as required by code, and by local authorities having jurisdiction. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and specific installation requirements of the damper UL listing.

K. Install heating coils, cooling coils, air filters, dampers, and all other duct-mounted accessories in air ducts where indicated on Drawings.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials both before and after installation. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

M. Elbows: Use long-radius elbows wherever they fit.

1. Fabricate 90-degree rectangular mitered elbows to include turning vanes.
2. Fabricate 90-degree round elbows with a minimum of three segments for 12 inches and smaller and a minimum of five segments for 14 inches and larger.

N. Branch Connections: Use lateral or conical branch connections.

O. Furnish splittler dampers and turning vanes at all tee connections.

3.2 ADDITIONAL INSTALLATION REQUIREMENTS FOR DUST HOOD EXHAUST DUCTS

A. Install ducts in accordance with Industrial Ventilation by The American Conference of Governmental Industrial Hygienists and the Round and Rectangular Industrial Duct Construction Standards by SMACNA.

B. Install exhaust ducts without dips and traps that may hold water. Slope ducts a minimum of 2 percent back to hood or inlet. Where indicated on Drawings, install trapped drain piping.

C. Cleanouts shall be provided in horizontal runs of ducts, near elbows, junctions and vertical runs. Spacing of cleanouts shall not exceed 12 feet for ducts of 12 inches in diameter and 8 feet for larger ducts.

D. All transitions shall be tapered. The taper should be at least five units long for each one unit change in diameter.

E. Connect duct to fan, hood, and other equipment indicated on Drawings.

3.3 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.4 DUCTWORK EXPOSED TO WEATHER

A. All external joints are to have secure watertight mechanical connections. Seal all openings to provide weatherproof construction.

B. Construct ductwork to resist external loads of wind, snow, ice, and other effects of weather. Provide necessary supporting structures.

C. Single Wall:
   1. Ductwork shall be galvanized steel.

a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting."

2. Where ducts have external insulation, provide weatherproof aluminum jacket. See Section 23 07 13 "Duct Insulation."

3.5 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts at a minimum to the following seal classes in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. All Air Ducts: Seal Class A.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "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.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

G. For dust collector, hangers and support shall be grounded.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

3.9 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

    a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.

    b. Duct located outdoors served by the DOAS unit: Test the total installed duct area installed outdoors including return/exhaust duct and supply duct.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Testing of each duct section is to be performed with access doors, coils, filters, dampers, and other duct-mounted devices in place as designed. No devices are to be removed or blanked off so as to reduce or prevent additional leakage.
5. Test for leaks before applying external insulation.
6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
7. Give seven days' advance notice for testing.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

3.11 STARTUP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.12 DUCT SCHEDULE

A. Fabricate ducts with galvanized sheet steel except as otherwise indicated and as follows:

1. Fabricate all ducts to achieve SMACNA pressure class, seal class, and leakage class as indicated below.

B. Supply/Return/General Exhaust Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

2. Recirculation Ducts Connected to Dust Collector Units:

a. Pressure Class: Positive 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.

3. Ducts Connected to Equipment Not Listed Above:

a. Pressure Class: Positive 2-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular:6
d. SMACNA Leakage Class for Round and Flat Oval: 3

C. Exhaust Ducts:

1. Ducts serving shower (10 ft from exhaust grille):

a. Type 304, stainless-steel sheet.

1) Concealed: No. 2B finish.

b. Pressure Class: Negative 2-inch wg.
c. Minimum SMACNA Seal Class: A.
d. SMACNA Leakage Class for Rectangular: 6.
e. SMACNA Leakage Class for Round and Flat Oval: 3.

2. Ducts Connected to Ovens

a. Double wall stainless steel unless equipment manufacturer accepts galvanized.
b. Pressure Class: Negative 2-inch wg.
c. Welded seams and joints.

3. Ducts Connected to dust collector, work table, exhaust hoods, dust hoods:

a. Pressure Class: Negative 20 inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Outdoor-Air Ducts (not filtered, cooled, or heated):

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units :

a. Pressure Class: Positive or negative 3 inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3 .

2. Exterior Ducts Connected to Air-Handling Units:

a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.

2. Stainless-Steel Ducts:

a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Galvanized.

F. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Velocity 1000 fpm or Lower:

1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.

b. Velocity 1000 to 1500 fpm:

1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:

1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."

a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

G. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."

    a. Rectangular Main to Rectangular Branch: 45-degree entry.
    b. Rectangular Main to Round Branch: Conical spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.

    a. Velocity 1000 fpm or Lower: Conical bell mouth tap.
    b. Velocity 1000 to 1500 fpm: Conical bell mouth tap.
    c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

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. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Fire dampers.
6. Flange connectors.
7. Turning vanes.
8. Remote damper operators.
9. Duct-mounted access doors.
10. Duct access panel assemblies.
11. Flexible connectors.

B. Related Requirements:

1. Section 23 33 46 "Flexible Ducts" for insulated and non-insulated flexible ducts.
2. Section 23 37 23 "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
3. Section 28 46 21.11 "Addressable Fire-Alarm Systems" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop, dynamic insertion loss, and self-generated noise data. Include breakout noise calculations for high-transmission-loss casings.

2. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

3. Detail duct accessories' fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

    a. Special fittings.
    b. Manual volume damper installations.
    c. Control-damper installations.
    d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor-damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, or BIM model, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A and NFPA 90B.

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck Fan Corporation.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin Company.

B. Description: Gravity balanced.

C. Performance:

1. Maximum Air Velocity: 1500fpm.
2. Maximum System Pressure: 6 inches wg.
3. AMCA Certification: Test and rate in accordance with AMCA 511.
4. Leakage:
   a. Class II: Leakage shall not exceed 10 cfm/sq. ft. against 1-inch wg differential static pressure.

D. Construction:

1. Frame:

   a. Hat shaped.
   b. 0.093-inch-thick extruded aluminum, with welded or mechanically attached corners and mounting flange.

2. Blades:

a. Multiple single-piece blades.
b. End pivoted, maximum 6-inch width, 0.050-inch-thick aluminum sheet with sealed edges.

3. Blade Action: Parallel.

E. Blade Seals: Extruded vinyl, mechanically locked.

F. Blade Axles:

1. Material: Aluminum.
2. Diameter: 0.20 inch.

G. Tie Bars and Brackets: Aluminum.

H. Return Spring: Adjustable tension.

I. Bearings: synthetic pivot bushings.

J. Accessories:
1. Counterweights and spring-assist kits for vertical airflow installations.
2. Screen Mounting:

a. Front or Rear mounted in sleeve.

1) Sleeve Thickness: 20 gauge minimum.
2) Sleeve Length: 6 inches minimum.

3. Screen Material: Aluminum.
4. Screen Type: Insect.
5. 90-degree stops.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Air Balance; a division of MESTEK, Inc.
b. American Warming and Ventilating; a Mestek Architectural Group company.
c. Greenheck Fan Corporation.
d. McGill AirFlow LLC.
e. Nailor Industries Inc.
f. Pottorff.
g. Ruskin Company.
h. Vent Products Co., Inc.

2. Performance:

a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Construction:

a. Linkage out of airstream.
b. Suitable for horizontal or vertical airflow applications.

4. Frames:

a. Hat-shaped, 18-gauge-thick, galvanized sheet steel.
b. Mitered and welded corners.
c. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized steel; 16 gauge thick.

6. Blade Axles: Galvanized steel.
7. Bearings:

a. Molded synthetic.
b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

8. Tie Bars and Brackets: Galvanized steel.
9. Locking device to hold damper blades in a fixed position without vibration.

B. Standard, Aluminum, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Warming and Ventilating; a Mestek Architectural Group company.
b. McGill AirFlow LLC.
c. Nailor Industries Inc.
d. Pottorff.
e. Ruskin Company.
f. Vent Products Co., Inc.

2. Performance:

a. Leakage Rating Class III: Leakage not exceeding 40 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Construction:

a. Linkage out of airstream.
b. Suitable for horizontal or vertical airflow applications.

4. Frames:

a. Hat-shaped, 0.10-inch-thick, aluminum sheet channels.
b. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
e. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.

6. Blade Axles: Stainless steel.
7. Bearings:

a. Oil-impregnated bronze or molded synthetic.
b. Dampers mounted with vertical blades to have thrust bearing at each end of every blade.

8. Tie Bars and Brackets: Aluminum.
9. Locking device to hold damper blades in a fixed position without vibration.

2.4 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a Mestek Architectural Group company.
2. Carnes Company.
3. Greenheck Fan Corporation.
4. McGill AirFlow LLC.
5. Nailor Industries Inc.
6. Pottorff.
7. Ruskin Company.
8. Vent Products Co., Inc.

B. General Requirements:

1. Unless otherwise indicated, use parallel-blade configuration for two-position control, equipment isolation service, and when mixing two airstreams. For other applications, use opposed-blade configuration.
2. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA 511.
2. Leakage:
   a. Class IA: Leakage shall not exceed 3 cfm/sq. ft. against 1-inch wg differential static pressure.
3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 3000 fpm.
5. Temperature: Minus 25 to plus 180 deg F.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Linkage out of airstream.
2. Suitable for horizontal or vertical airflow applications.
3. Frames:
   a. Hat, U, or angle shaped.
   b. 16-gauge-thick, galvanized sheet steel.
   c. Interlocking, gusseted corners.
   d. Flanges for attaching to walls and flangeless frames for installing in ducts.
4. Blades:
   a. Multiple blade with maximum blade width of 6 inches.
   b. Opposed-blade design.
   c. Galvanized steel.
   d. 16-gauge-thick single skin.
5. Blade Edging Seals:
   a. TPE
6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; galvanized steel.
8. Blade-Linkage Hardware: Zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of air stream.
9. Bearings:
   a. Molded synthetic.
   b. Dampers mounted with vertical blades to have thrust bearings at each end of every blade.

E. Damper Actuator - Electric:

1. Electric - 24 V ac.
2. UL 873, plenum rated.
3. Two position with fail-safe spring return.

a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
b. Minimum 90-degree drive rotation.

4. Clockwise or counterclockwise drive rotation as required for application.
5. Environmental Operating Range:

a. Temperature: Minus 40 to plus 130 deg F.
b. Humidity: 5 to 95 percent relative humidity noncondensing.

6. Environmental enclosure: NEMA 2.
7. Actuator to be factory mounted and provided with a single-point wiring connection.

F. Controllers, Electrical Devices, and Wiring:

1. Electrical Connection: 24 V, 60 Hz.

2.5 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance; a division of MESTEK, Inc.
2. Aire Technologies.
3. Greenheck Fan Corporation.
4. Pottorff.
5. Ruskin Company.
6. Vent Products Co., Inc.

B. Type: dynamic; rated and labeled in accordance with UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.

D. Fire Rating: 1-1/2.

E. Frame: Curtain type with blades inside airstream; fabricated with roll-formed galvanized steel; with mitered and interlocking corners; gauge in accordance with UL listing.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel; gauge in accordance with UL listing.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed galvanized sheet steel,. Material gauge is to be in accordance with UL listing.

I. Horizontal Dampers: Include blade lock and stainless steel closure spring.

J. Heat-Responsive Device:

1. Replaceable, 165 deg F rated, fusible links.

2.6 SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance; a division of MESTEK, Inc.
2. Aire Technologies.
3. Greenheck Fan Corporation.
4. Pottorff.
5. Ruskin Company.

B. General Requirements:

1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
3. Unless otherwise indicated, use parallel-blade configuration.
4. Factory or field assemble multiple damper sections to provide a single damper assembly of size required by the application.
5. Factory install damper actuator by damper manufacturer as integral part of damper assembly. Coordinate actuator location, mounting, and electrical requirements with damper manufacturer.

C. Performance:

1. AMCA Certification: Test and rate in accordance with AMCA Publication 511.
2. Leakage:
   a. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Pressure Drop: 0.05 inch wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 3000 fpm.
5. Temperature: Minus 25 to plus 180 deg F.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

D. Construction:

1. Suitable for horizontal or vertical airflow applications.
2. Linkage out of airstream.
3. Frame:

   a. Hat shaped.
   b. Galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.
   c. Gauge in accordance with UL listing.

4. Blades:

    a. Roll-formed, horizontal, v-groove, galvanized sheet steel.
    b. Maximum width and gauge in accordance with UL listing.

5. Blade Edging Seals:

    a. Silicone rubber.

6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage is to be mounted out of airstream.
8. Bearings:

    a. Oil-impregnated stainless steel sleeve.

E. Mounting Sleeve: Factory-installed, galvanized sheet steel; length to suit wall or floor application; gauge in accordance with UL listing.

F. Damper Actuator - Electric:

1. Electric - 24 V ac.
2. UL 873, plenum rated.
3. Designed to operate in smoke-control systems complying with UL 555S requirements.
4. Two position with fail-safe spring return.

    a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
    b. Maximum 15-second full-stroke closure.
    c. Minimum 90-degree drive rotation.

5. Clockwise or counterclockwise drive rotation as required for application.
6. Environmental Operating Range:

    a. Temperature: Minus 40 to plus 130 deg F.
    b. Humidity: 5 to 95 percent relative humidity noncondensing.

7. Environmental Enclosure: NEMA 2.
8. Actuator to be factory mounted and provided with single-point wiring connection.

G. Controllers, Electrical Devices, and Wiring:

1. Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."
2. Electrical Connection: 24 V, 60 Hz.

H. Accessories:

1. Auxiliary switches for signaling or position indication.

2. Test and reset switches, damper mounted.

2.7 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Air Balance; a division of MESTEK, Inc.
2. Aire Technologies.
3. Greenheck Fan Corporation.
4. Pottorff.
5. Ruskin Company.

B. General Requirements:

1. Label to indicate conformance to UL 555 and UL 555S by an NRTL.
2. Label to indicate conformance to NFPA 80 and NFPA 90A by an NRTL.
3. Unless otherwise indicated, use parallel-blade configuration.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000 fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Performance:

1. AMCA Certification: Test and rate in accordance with AMCE Publication 511.
2. Leakage:
   a. Class I: Leakage shall not exceed 4 cfm/sq. ft. against 1-inch wg differential static pressure.

3. Pressure Drop: 0.05 in. wg at 1500 fpm across a 24-by-24-inch damper when tested in accordance with AMCA 500-D, Figure 5.3.
4. Velocity: Up to 3000 fpm.
5. Temperature: Minus 25 to plus 180 deg F.
6. Pressure Rating: Damper close-off pressure equal to fan shutoff pressure with a maximum blade deflection of 1/200 of blade length.

F. Construction:

1. Suitable or horizontal or vertical airflow applications.
2. Linkage out of airstream.
3. Frame:

   a. Hat shaped.
   b. Galvanized sheet steel, with interlocking, gusseted or mechanically attached corners and mounting flange.
   c. Gauge is to be in accordance with UL listing.

4. Blades:

a. Roll-formed, horizontal, v-groove, galvanized sheet steel.
b. Maximum width and gauge in accordance with UL listing.

5. Blade Edging Seals:

a. Silicone rubber.

6. Blade Jamb Seal: Flexible stainless steel, compression type.
7. Blade Axles: 1/2-inch-diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings. Linkage mounted out of airstream.
8. Bearings:

a. Oil-impregnated stainless steel sleeve.

G. Mounting Sleeve:

1. Factory installed, galvanized sheet steel.
2. Length to suit wall or floor application.
3. Gauge in accordance with UL listing.

H. Heat-Responsive Device:

1. Resettable, 165 deg F rated, fire-closure device.
2. Electric resettable deviceand switch package, factory installed, rated.

I. Damper Actuator - Electric:

1. Electric - 24 V ac.
2. UL 873, plenum rated.
3. Designed to operate in smoke-control systems complying with UL 555S requirements.
4. Two position with fail-safe spring return.

a. Sufficient motor torque and spring torque to drive damper fully open and fully closed with adequate force to achieve required damper seal.
b. Maximum 15-second full-stroke closure.
c. Minimum 90-degree drive rotation.

5. Clockwise or counterclockwise drive rotation as required for application.
6. Environmental Operating Range:

a. Temperature: Minus 40 to plus 130 deg F.
b. Humidity: 5 to 95 percent relative humidity noncondensing.

7. Environmental Enclosure: NEMA 2.
8. Actuator to be factory mounted and provided with single-point wiring connection.

J. Controllers, Electrical Devices, and Wiring:

1. Comply with requirements for electrical devices and connections specified in Section 23 09 23 "Direct Digital Control (DDC) System for HVAC."

2. Electrical Connection: 24 V, 60 Hz.

K. Accessories:

1. Auxiliary switches for signaling or position indication.
2. Test and reset switches, damper mounted.

2.8 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aero-Dyne Sound Control Co.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. DynAir; a Carlisle Company.

B. Manufactured Turning Vanes for Metal Ducts: Fabricate curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."

D. Vane Construction:
1. Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.9 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. DynAir; a Carlisle Company.
2. Metropolitan Air Technology
3. United Enertech.
4. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Cable: Steel.

D. Wall-Box Mounting: Recessed.

E. Wall-Box Cover-Plate Material: Steel.

2.10 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aire Technologies.
2. CL WARD & Family Inc.
3. Ductmate Industries, Inc.
4. Duro Dyne Inc.
5. Flexmaster U.S.A., Inc.
6. McGill AirFlow LLC.
7. Ruskin Company.
8. United Enertech.
9. Ventfabrics, Inc.
10. Ward Industries; a brand of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figure 7-2 (7-2M), "Duct Access Doors and Panels," and Figure 7-3, "Access Doors - Round Duct."

1. Door:

   a. Double wall, rectangular.
   b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
   c. 24-gauge-thick galvanized steel or 0.032-inch thick aluminum door panel.
   d. Vision panel.
   e. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
   f. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

   a. 24-gauge-thick galvanized steel or 0.032-inch-thick aluminum frame.

3. Number of Hinges and Locks:

   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
   b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
   c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches.
   d. Access Doors Larger Than 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.

2. Door: Single wall with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0 to 8.0 inches wg.

5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.11 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CL WARD & Family Inc.
2. Ductmate Industries, Inc.
3. Flame Gard, Inc.

B. Panel and Frame: Minimum thickness 16-gauge stainless steel.

C. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

D. Gasket: Comply with NFPA 96, grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

E. Minimum Pressure Rating: 10 inches wg positive or negative.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ward Industries; a brand of Hart & Cooley, Inc.

B. Fire-Performance Characteristics: Adhesives, sealants, fabric materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested in accordance with ASTM E84.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Materials: Flame-retardant or noncombustible fabrics.

E. Coatings and Adhesives: Comply with UL 181, Class 1.

F. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..

2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

G. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd..
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

H. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.13 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories in accordance with applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116 for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless steel accessories in stainless steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft or control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Where multiple damper sections are necessary to achieve required dimensions, provide reinforcement to fully support damper assembly when fully closed at full system design static pressure.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

1. Install steel volume dampers in steel ducts.
2. Install aluminum volume dampers in aluminum ducts.

F. Set dampers to fully open position before testing, adjusting, and balancing.

G. Install test holes at fan inlets and outlets and elsewhere as indicated and as needed for testing and balancing.

H. Install fire and smoke dampers in accordance with UL listing.

I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans and seals.
5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
7. At each change in direction and at maximum 50-ft. spacing.
8. Control devices requiring inspection.
9. Elsewhere as indicated.

J. Install access doors with swing against duct static pressure.

K. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

L. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

M. Install flexible connectors to connect ducts to equipment.

N. For fans developing static pressures of 5 inches wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

O. Install duct test holes where required for testing and balancing purposes.

P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors, and verify that size and location of access doors are adequate to perform required operation.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation, and verify that vanes do not move or rattle.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 23 33 46

FLEXIBLE DUCTS

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. Insulated flexible ducts.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For flexible ducts.

1. Include plans showing locations and mounting and attachment details.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from installers of the items involved.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

C. Comply with the Air Diffusion Council's "ADC Flexible Air Duct Test Code FD 72-R1."

D. Comply with ASTM E96/E96M, "Test Methods for Water Vapor Transmission of Materials."

2.2 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Thermaflex; a Flex-Tek Group company.
4. Ward Industries; a brand of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, triple lock aluminum with reinforced metalized vapor barrier, fiberglass insulation and triple lock standard aluminum duct.

1. Pressure Rating: 10-inch wg positive through 16” and 12.0-inch wg negative through 16”.
2. Maximum Air Velocity: 5500 fpm.
3. Temperature Range: Minus 40 to plus 250 deg F.
4. Insulation R-Value: R-8.

2.3 FLEXIBLE DUCT CONNECTORS

A. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install flexible ducts according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install in indoor applications only. Flexible ductwork should not be exposed to UV lighting.

C. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.

D. Connect diffusers or light troffer boots to ducts with maximum 48-inch lengths of flexible duct clamped or strapped in place.

E. Connect flexible ducts to metal ducts with draw bands.

F. Install duct test holes where required for testing and balancing purposes.

G. Installation:

1. Install ducts fully extended.
2. Do not bend ducts across sharp corners.
3. Bends of flexible ducting shall not exceed a minimum of one duct diameter.
4. Avoid contact with metal fixtures, water lines, pipes, or conduits.
5. Install flexible ducts in a direct line, without sags, twists, or turns.

H. Supporting Flexible Ducts:

1. Suspend flexible ducts with bands 1-1/2 inches wide or wider and spaced a maximum of 48 inches apart. Maximum centerline sag between supports shall not exceed 1/2 inch per 12 inches.
2. Install extra supports at bends placed approximately one duct diameter from center line of the bend.
3. Ducts may rest on ceiling joists or truss supports. Spacing between supports shall not exceed the maximum spacing per manufacturer's written installation instructions.
4. Vertically installed ducts shall be stabilized by support straps at a maximum of 72 inches o.c.

END OF SECTION

SECTION 23 34 16

CENTRIFUGAL HVAC FANS

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. Square in-line centrifugal fans.
2. Overhead vehicle exhaust removal system
3. Utility set fans.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolatorsand for designing vibration isolation bases.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Fan room layout and relationships between components and adjacent structural and mechanical elements, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For centrifugal fans to include in normal operation, emergency operation, and maintenance manuals with replacement parts listing.

1.6 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. Belts: One set(s) for each belt-driven unit.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified

warranty period. Contractor shall guarantee all installed equipment, material, and work against any defects in material or workmanship and shall satisfactorily correct, at no cost to the State, any such defect that may become apparent within a period of one year after completion of the installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.2 SQUARE IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carnes Company.
2. Greenheck Fan Corporation.
3. Loren Cook Company.
4. PennBarry.

B. Description: Square in-line centrifugal fans.

C. Housing:

1. Housing Material: Reinforced steel.
2. Housing Coating: None.
3. Housing Construction: Side panels shall be easily removable for service. Include inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Fan Wheels: Aluminum airfoil blades welded to aluminum hub.

F. Motor Enclosure: Open, dripproof.

G. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent. Dial on exterior of fan housing.
3. Companion Flanges: For inlet and outlet duct connections.
4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.
5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.
6. Backdraft damper.
7. Junction box mounted and wired.
8. NEMA-1 switch.
9. 7-Programmable thermostat with step down transformer where indicated in the schedule in the drawings.
10. Provide 2 fan speed controller where indicated in the schedule in the drawings.

2.3 OVERHEAD VEHICLE EXHAUST REMOVAL - UTILITY SET FANS

A. Overhead vehicle exhaust removal system shall match design intent indicated in Contract Documents. Manufacturer shall provide all components required to have a full operational system including but not limited to: exhaust fan, overhead ductwork, connections, hose reels, hoses, exhaust adapters, controller.

B. System shall be designed by manufacturer to operate with diesel, propane, and gasoline vehicles.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Car-mon
2. EuroVent
3. Monoxivent

D. UTILITY SET FAN

1. Description:
   a. Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fan utility vent sets, consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.
   b. Fan shall be single inlet, single width and shall have a backward inclined fan wheel with single thickness flat blades. The fan blades shall be continuously welded to the shroud and the backplate. The fan blades shall be free of weld spatter. The hub shall be bolted to the fan wheel with Grade 5 bolts. The fan wheel shall be statically and dynamically balanced before assembly. Any required balance weights shall be welded to the outside of the shroud or backplate.
   c. The bearings shall be of pillow block type with cast steel frame and shall be bolted to the structural angle bearing supports. The fan shaft shall be fabricated of ground and polished cold drawn steel with machined centers and key slots for both the fan

wheel and the drive sheave. It shall be given a rust inhibitive asphaltic coating after assembly. The V-belt drive shall be adjustable. The variable pitch sheave shall be factory set at the appropriate position to provide the specified capacity in the approximate midpoint of the adjustment range. All fans shall be provided with a belt guard enclosing both sheaves and V-belts. The belt guard shall have a tachometer hole. The drive shall have two V-belts and be rated for no less than 150% of motor load.

d. The scroll and side sheets of the fan housing shall be fabricated of cold rolled steel 12-gauge minimum thickness. The scroll and side sheets shall be joined through continuous welding. Spot welded or standing seam construction is not acceptable. The fan housing shall have a minimum of 8 attachment studs welded to each side sheet, one to which the inlet cone and inlet support shall bolt, and the other for joining the housing to the base.

e. The fan base and the inlet support shall be fabricated of cold rolled steel of 12-gauge minimum thickness. The bearing supports within the base shall be fabricated of cold rolled steel angles having a minimum 3/16” thickness and they shall be welded to the sides of the base. All seams in the individual components shall be continuous welded.

f. The motor base shall be fabricated of cold rolled steel of 10-gauge minimum thickness. Its position shall be adjustable through the use of bolts that travel in slots in the sides of the fan base. All surfaces of the centrifugal fan shall be painted completely with a polyester powder coating.

g. The assembled fan shall be test run before shipment with total frequency vibration measured at each bearing in both the vertical and horizontal planes. Balance report to be provided with installation and maintenance instructions.

2. Accessories:
   a. Furnish welded steel fan platform to match specified fan with vibration rails.
   b. Fan accessories shall be manufactured by vehicle exhaust system manufacturer.
   c. Inlet and discharge flex connection.
   d. Backdraft damper: aluminum construction with aluminum damper blades, nylon bearings and felt pad seal.

E. HOSE ASSEMBLY

1. Tubing storage reel with welded steel frame, airtight rotating cylinder with recessed inlet fitting to which the flange mounted flexible hose will be bolted. The assembly is spring actuated with a ratchet locking device and integral stop.

2. Manufacturer shall provide adequate tubing length for project. Tubing storage reel with spring operator with tail pipe adapter.

3. Assembly shall include flex hose, storage reel, exhaust adapter and flange set.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

B. Where variable-frequency drives are indicated or scheduled, provide fan motor compatible with variable-frequency drive.

2.5 SOURCE QUALITY CONTROL

A. AMCA Certification for Fan Sound Performance Rating: Test, rate, and label in accordance with AMCA 311.

B. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.

C. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

D. Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install centrifugal fans level and plumb.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

D. Equipment Mounting:
   1. Support duct-mounted and other hanging centrifugal fans directly from the building structure, using suitable hanging systems as specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
   2. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

E. Vehicle exhaust system shall be installed per manufacturer installation instructions.

F. Install units with clearances for service and maintenance.

G. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK AND PIPING CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
   1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."

3.5 .STARTUP SERVICE:

A. Perform startup service.

   1. Complete installation and startup checks in accordance with manufacturer's written instructions.
   2. Verify that shipping, blocking, and bracing are removed.
   3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   4. Verify that cleaning and adjusting are complete.
   5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.

6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

D. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Fans and components will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

SECTION 23 34 23

HVAC POWER VENTILATORS

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. Sidewall propeller fans.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes for fans.
2. Rated capacities, operating characteristics, and furnished specialties and accessories.
3. Certified fan performance curves with system operating conditions indicated.
4. Certified fan sound-power ratings.
5. Motor ratings and electrical characteristics, plus motor and electrical accessories.
6. Material thickness and finishes, including color charts.
7. Dampers, including housings, linkages, and operators.
8. Prefabricated roof curbs.
9. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Design Calculations: Calculate requirements for selecting vibration isolators.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, or BIM model, drawn to scale, showing the items described in this Section and coordinated with all building trades.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVAC power ventilators to include in normal and emergency operation, and maintenance manuals.

1.6 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. Belts: One set(s) for each belt-driven unit.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period. Contractor shall guarantee all installed equipment, material, and work against any defects in material or workmanship and shall satisfactorily correct, at no cost to the State, any such defect that may become apparent within a period of one year after completion of the installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.2 SIDEWALL PROPELLER FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Greenheck
2. Loren Cook Company.
3. PennBarry.

B. Housing: Galvanized-steel sheet with flanged edges and integral orifice ring, with baked-enamel finish coat applied after assembly.

C. Fan Wheel: Replaceable, cast-aluminum, airfoil blades fastened to cast-aluminum hub; factory set pitch angle of blades.

D. Fan construction shall meet AMCA Spark B.

E. Fan Drive, Direct: Direct-drive motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

F. Accessories:
1. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
2. Dampers: Counterbalanced, parallel-blade, backdraft dampers factory set to close when fan stops.
3. Motorized Dampers: Parallel-blade dampers with electric actuator wired to close when fan stops.
4. Motor-Side Back Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
5. Wall Housing Sleeve: Galvanized steel to match fan and accessory size.

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.4 SOURCE QUALITY CONTROL

A. AMCA Certification for Fan Aerodynamic Performance Ratings: Test, rate, and label in accordance with AMCA 211.

B. AMCA Certification for Fan Energy Index (FEI): Test, rate, and label in accordance with AMCA 211.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install power ventilators level and plumb.

B. Install units with clearances for service and maintenance.

C. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.2 DUCTWORK CONNECTIONS

A. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 23 33 00 "Air Duct Accessories."

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.
1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch (13 mm) high.

3.4 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring according to Section 26 05 23 "Control-Voltage Electrical Power Cables."

3.5 STARTUP SERVICE:

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Verify that shipping, blocking, and bracing are removed.
3. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. For direct-drive fans, verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
6. For belt-drive fans, disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.
12. Shut unit down and reconnect automatic temperature-control operators.
13. Remove and replace malfunctioning units and retest as specified above.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Lubricate bearings.

C. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

3.7 CLEANING

A. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections with the assistance of a factory-authorized service representative.

1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties.
3. Fans and components will be considered defective if they do not pass tests and inspections.
4. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION

SECTION 23 34 39

HIGH-VOLUME, LOW-SPEED FANS

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 high-volume, low-speed fans.

1.3 DEFINITIONS

A. HVLS - High volume, low speed.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, furnished specialties, and accessories for each fan.
2. Certified fan performance curves with system operating conditions indicated.
3. Certified fan sound-power ratings.
4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
5. Material thickness and finishes, including color charts.
6. Fan speed controllers.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Show dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For each HVLS fan.

1. Include design calculations and details for selecting product mounting components and seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

2. Design Calculations: Calculate static and dynamic loading due to equipment weight, operation, and seismic forces required to select mounting components and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Qualification Data:

1. For Installer: Certificate from HVLS fan manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, controls, and accessories indicated and furnished for installation.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For HVLS fans to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide certification that manufacturer complies with the most recent edition of ISO 9001.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by HVLS fan manufacturer.

1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, controls, and accessories indicated and furnished for installation.
2. Installer certification shall be valid and current for duration of Project.
3. Retain copies of Installer certificates on-site and make available on request.
4. Each person assigned to Project shall have demonstrated past experience.

    a. Demonstrated past experience with products being installed for period within five consecutive years before time of bid.
    b. Demonstrated past experience on five projects of similar complexity, scope, and value.

C. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

D. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

E. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in a clean and dry place.

B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.

C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.

D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.

1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.

E. Replace installed products damaged during construction.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period. Contractor shall guarantee all installed equipment, material, and work against any defects in material or workmanship and shall satisfactorily correct, at no cost to the State, any such defect that may become apparent within a period of one year after completion of the installation.

1. Warranty Period:

a. For Motor, Including Controls: 10 year(s) from date of Substantial Completion.
b. For Parts, Including Blades and Hub: 10 year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Listed and labeled to UL 507.

C. CSA Compliance: Listed and labeled to CSA C22.2, No. 113.

D. Comply with NFPA 13 requirements for HVLS fans.

E. AMCA Compliance:

1. Test HVLS fans according to AMCA 230.
2. Certify HVLS fan performance according to AMCA 211.

F. Performance Data: Comply with ANSI 230 test procedure standard, based on five rating points: 20-, 40-, 60-, 80-, and 100-percent of maximum speed. Comply with AMCA 211 for publication of performance data.

G. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design HVLS ceiling fans.

2.2 CAPACITIES AND CHARACTERISTICS

2.3 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Big Ass Fans.
2. Greenheck.
3. MacroAir.

B. Source Limitations: Obtain HVLS fans from single source from single manufacturer.

2.4 HIGH-VOLUME, LOW-SPEED FANS

A. Description: Factory-assembled and -tested horizontal, non-ducted fan unit, consisting of large-diameter blade set, direct-drive electric motor, with variable-speed motor controller.

1. Provide fan designed to circulate large air volume, vertically, at low velocity.
2. Maximum Operating Temperature: 140 deg F.
3. Frame:

a. Material: Galvanized steel.

4. Blades: Airfoil type.

   a. Quantity: 5.
   b. Material: Aluminum.

      1) Blade Finish: Mill finish.

5. Wiring and Controls Enclosure:

   a. NEMA 250, Class 1.
   b. Material: Aluminum or galvanized steel.

      1) Enclosure Finish: Anodized.

   c. Grounded.

6. Controls: Provide wall-mounted keypad.

   a. Provide variable speed motor controller speed control.

7. Maximum Sound Power Level: 50 dBA.
8. Standard Mounting Bracket: Steel beam/steel angle.
9. Mounting Bracket: Large beam or Solid beam or Z-purlin.
10. Accessories:

    a. Mounting extension tube.
    b. Steel truss mounting kit.
    c. Safety Cable.
    d. Guy wires.
    e. Disconnect switch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting HVLS fan performance, maintenance, and operations.

   1. Fan locations indicated on Drawings are approximate. Determine exact locations before roughing-in for mounting, control, and electrical connections.

B. Examine roughing-in for mounting location, anchor-bolt sizes, and locations, to verify actual locations for mounting connections before installation of fan.

C. Examine areas for suitable conditions where fan will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF HIGH-VOLUME LOW-SPEED FANS

A. Install fan according to manufacturer's published instructions.

B. Comply with NECA 1 and NFPA 70.

C. Comply with NFPA 13 for installation of HVLS fans and maximum allowable fan diameter. Center HVLS fans between four adjacent sprinklers. Minimum vertical clearance from HVLS fan to sprinkler deflector is 3 feet.

D. Comply with NFPA 72 and interlock HVLS fans to shut down upon receiving an alarm from fire alarm system.

E. Equipment Mounting:

1. Anchor fan to building structure with manufacturer's recommended mounting bracket for installed condition.
2. Consult a licensed professional structural engineer for mounting methods and approval for mounting to the structure. Structure must be able to withstand the torque and forces generated by the fan.
3. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
4. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

F. Install unit to permit access for maintenance.

G. Install parts and accessories shipped loose.

3.3 ELECTRICAL CONNECTIONS

A. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
1. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

E. Install power wiring to field-mounted electrical devices, furnished by fan manufacturer, but not factory mounted.

3.4 CONTROL CONNECTIONS

A. Connect control wiring to field-mounted control devices.

B. Connect control wiring according to Section 26 05 23 "Control-Voltage Electrical Power Cables."

C. Connect control interlock wiring between HVLS fan and other equipment to provide a complete and functioning system.

D. Connect control wiring between fan unit control interface and control system to provide remote control and monitoring.

E. Install control devices furnished by manufacturer, but not factory mounted.

F. Install control wiring to field-mounted control devices, furnished by fan manufacturer, but not factory mounted.

G. Protect installed units from damage caused by other work.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Fan or components will be considered defective if fan or components do not pass tests and inspections.

C. Prepare and submit test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that fan is secure on mountings and supporting devices and that connections to electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers and switches.
3. Verify proper motor rotation direction and free fan rotation.
4. Check bearing lubrication.
5. Verify proper fan rotation. Set rotation selector to blow vertically downward during heating season, and vertically upward during cooling season.

3.7 ADJUSTING

A. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.

3.8 CLEANING

A. Clean equipment externally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions. Following manufacturer's cleaning procedures, and clean with manufacturer-recommended cleaning products.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVLS fans.

END OF SECTION

SECTION 23 37 13.13

AIR DIFFUSERS

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. Rectangular and square ceiling diffusers.

B. Related Requirements:

   1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers.
   2. Section 23 37 13.23 "Air Registers and Grilles" for adjustable-bar register and grilles, fixed-face registers and grilles, and linear bar grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   2. Diffuser Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

B. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

PART 2 - PRODUCTS

2.1 RECTANGULAR AND SQUARE CEILING DIFFUSERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Krueger-HVAC, a division of Air System Components; Johnson Controls, Inc.
2. METALAIRE, Inc.
3. Nailor Industries Inc.
4. Price Industries.
5. Titus, a division of Air System Components; Johnson Controls, Inc.

B. Material: Aluminum.

C. Finish: Baked enamel, white.

D. Face Size: As shown in drawings.

E. Face Style: As scheduled.

F. Mounting: T-bar.

G. Pattern: Fixed.

H. Accessories:

1. Plaster ring for gypboard applications.

2. Integral balancing dampers for unaccessible ceilings.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 37 13.23

REGISTERS AND GRILLES

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. Adjustable blade face grilles.
2. Fixed face grilles.

B. Related Requirements:

1. Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to registers and grilles.
2. Section 23 37 13.13 "Air Diffusers" for various types of air diffusers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Register and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples: For each exposed product and for each color and texture specified. Smallest size register and grille indicated.

C. Samples for Initial Selection: For registers and grilles with factory-applied color finishes. Smallest size register and grille indicated.

D. Samples for Verification: For registers and grilles, in manufacturer's standard sizes to verify color selected. Smallest size register and grille indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

PART 2 - PRODUCTS

2.1 GRILLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Krueger-HVAC, a division of Air System Components; Johnson Controls, Inc.
2. METALAIRE, Inc.
3. Nailor Industries Inc.
4. Price Industries.
5. Titus, a division of Air System Components; Johnson Controls, Inc.

B. Adjustable Blade Face Grille:

1. Material: Aluminum.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Vertical spaced 3/4 inch apart.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
6. Frame: 1 inch wide.
7. Mounting: Countersunk screw.

C. Fixed Face Grille:

1. Material: Aluminum as indicated in drawings.
2. Finish: Baked enamel, white.
3. Face Blade Arrangement: Vertical; spaced 3/4 inch apart.
4. Core Construction: Integral.
5. Frame: 1 inch wide.
6. Mounting: Countersunk screw.

D. Eggcrate Grille:

1. Material: Aluminum as indicated in drawings.
2. Finish: Baked enamel, white.
3. Face Arrangement: ½ by ½ by ½ inch core.
4. Core Construction: Integral.
5. Rear-Blade Arrangement: Horizontal spaced 3/4 inch apart.
6. Frame: 1-3/4 inch wide.
7. Mounting: Countersunk screw.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate registers and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where registers and grilles are installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install registers and grilles level and plumb.

B. Outlets and Inlets Locations: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install registers and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

D. All visible interior of ductwork connected to a return grille shall be painted flat black.

3.3 ADJUSTING

A. After installation, adjust registers and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 23 51 16

FABRICATED BREECHINGS AND ACCESSORIES

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. Listed, refractory-lined breechings.
2. Field-fabricated metal breechings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for product.

B. Shop Drawings: For breechings.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.

2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in breechings.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

C. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

D. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

E. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, structural failures caused by expansion and contraction.
2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LISTED, REFRACTORY-LINED METAL BREECHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Van-Packer Company, Inc.
2. Warren Environment, Inc.

B. Comply with ASME STS-1.

C. Design Wind Loads: 150 mph.

D. Refractory Lining: Tested according to UL 959 for temperature and acid resistance and bearing the testing laboratory label.

1. Temperature Rating: 1800 deg F continuously and 2000 deg F intermittently.
2. Acid Extraction: Maximum of 0.2 percent.
3. Cold Crushing Strength: Minimum of 3200 psig.
4. Thickness: Minimum of 2 inches.

2.2 FIELD-FABRICATED METAL BREECHINGS

A. Fabricate breechings from ASTM A1011/A1011M hot-rolled steel with continuously welded joints, complying with NFPA 211 for minimum metal thickness.

1. Equal to or Less Than 1.069 Sq. Ft. or 14 Inches in Diameter: 0.053 inch.
2. Up to 1.396 Sq. Ft. or 16 Inches in Diameter: 0.067 inch.
3. Up to 1.764 Sq. Ft. or 18 Inches in Diameter: 0.093 inch.
4. Larger Than 1.764 Sq. Ft. or 18 Inches in Diameter: 0.123 inch.

B. Fabricate cleanout doors from compatible material, same thickness as breeching, bolted and gasketed.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed, Refractory-Lined Metal Breechings: Freestanding dual-fuel boiler vents, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.

B. Field-Fabricated Metal Breechings: Dual-fuel boilers, oven vents, water heaters, exhaust for engines, fireplaces, and other solid-fuel-burning appliances.

3.3 INSTALLATION OF UNLISTED, FIELD-FABRICATED BREECHINGS

A. Suspend breechings independent of their appliance connections.

B. Align breechings at connections, with smooth internal surface and a maximum 1/8-inch misalignment tolerance.

C. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

D. Lap joints in direction of flow.

E. Support breechings from building structure with bolts, concrete inserts, steel expansion anchors, welded studs, C clamps, or beam clamps according to manufacturer's written instructions.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings that are not completed or connected to equipment.

END OF SECTION

SECTION 23 51 23

GAS VENTS

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. Listed single- wall vents.

2. Listed double-wall vents.

B. Related Requirements:
1. Section 23 51 16 "Fabricated Breechings and Accessories" for listed, refractory-lined metal breechings and field-fabricated metal breechings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for product.

B. Shop Drawings: For vents.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of hangers and seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for shop and field welding of joints and seams in vents.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

C. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

D. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

E. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

PART 2 - PRODUCTS

2.1 SINGLE WALL VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Roberts Gordon
2. Van-Packer Co.

B. Description: Single-wall metal vents tested according to UL file MH45778 and rated for maximum operating temperature of 550 deg F and may be used with negative, neutral, and positive vent pressures.

2.2 LISTED TYPE B AND BW VENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amerivent
2. Hart & Cooley Inc.
3. M&G DuraVent, Inc.; a member of the M&G Group.
4. Metal-Fab, Inc.
5. Selkirk Corporation.

B. Description: Double-wall metal vents tested according to UL 441 and rated for 480 deg F continuously for Type B or 550 deg F continuously for Type BW; with neutral or negative flue pressure complying with NFPA 211.

C. Construction: Inner shell and outer jacket separated by at least a 1/4-inch airspace.

D. Inner Shell: ASTM B209, Type 1100 aluminum ASTM B209, Type 3003 aluminum ASTM B209, or Type 3105 aluminum.

E. Outer Jacket: Galvanized steel.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Stack cap designed to exclude minimum 90 percent of rainfall.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

A. Listed Type B and BW Vents: Vents for certified gas appliances. Vent pipe passing through roof or wall only. Vents in the building must be single wall vent pipe.

B. Single wall vents: as indicated by equipment manufacturer.

3.3 INSTALLATION OF LISTED VENTS

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07 72 00 "Roof Accessories."

B. Comply with minimum clearances from combustibles and minimum termination heights according to product listing or NFPA 211, whichever is most stringent.

C. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

D. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

E. Lap joints in direction of flow.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION

SECTION 23 51 43

MECHANICAL DUST COLLECTOR

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 mechanical dust collector.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For mechanical dust collector to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period. Contractor shall guarantee all installed equipment, material, and work against any defects in material or workmanship and shall satisfactorily correct, at no cost to the State, any such defect that may become apparent within a period of one year after completion of the installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Camfil
2. Donaldson Filtration Solutions
3. Micro Air Dust Collection Systems

2.2 DESCRIPTION

A. Assembly including casing, filter, collector, hopper, silencer, air inlet, fan, supports, motor, controller. Dust collector shall be of modular construction.

2.3 CONSTRUCTION

A. Construction shall be of minimum 10 gauge steel. Major sections shall be modular, bolted construction. The collector consists of filter module sections and hopper sections with support legs.

B. The filter module shall contain the cartridge filter elements, reverse pulse cleaning system, clean air plenum and cartridge removal/replacement sealing hardware with support frame and side walls. The filter module shall have an inlet plenum box on the side. This inlet plenum box shall contain an internal perforated baffle for cross air flow design. The plenum box will be designed to provide low inlet velocities and thus maximum fall out of particles down into the hopper section as they strike the baffle.

C. Cartridge filters shall be installed vertically, and removed by sliding on tracks accessible by doors. Doors shall be heavy duty of formed 10-gauge design, with mechanically attached seal.

D. Doors are sealed by a heavy-duty lift cambar mechanism. No knobs shall be used on the door. Door design is fully reversible in that the same door can be used at either side of the collector. The door shall have lock out and tagging capability.

E. Cartridges shall be self-positioning and an entire row shall be locked and sealed in place by means of tracks which are cam locking bars with handles at the door end to easily lock/unlock the cartridges into place. Cam bars are supported by heavy-duty, cast-iron support clips.

F. Media shall be corrugated into pleated cylinder design, with dimpled pleats. Cartridges shall have molded urethane round headers at the top and bottom. Attached to the top header plate shall be a rectangular stamped pan, that can be easily slid in/out on the cam bar tracks. The top header plate is removable, re-usable. The cartridge must be easily crushed and be incinerable for disposal. The rectangular pan shall have metal tabs so that cartridges cannot accidentally be slid on top of each other.

G. Internal to the cartridge shall be an internal media cone, which provides additional media and enhances reverse cleaning. This internal cone shall have a bottom opening in the bottom urethane header, which reduces the area of the header, and reduces overall can velocity effect. The top of the internal media cone shall have an injection molded piece for support and reverse airflow cleaning enhancement. The cartridge shall have twin (2) gaskets on top of the cartridge. These shall be cast into the urethane top of the cartridge. The gaskets are continuous design; strip and glued gaskets are not acceptable. Gaskets shall not be directly exposed to the dirty air stream. Sealing and contact of cartridges can be verified by line of sight viewing from the door of the collector. There shall be a helical cord retainer on the outside of the cartridge to retain shape during back pulsing. This cord retains the cartridge shape and pleat spacing yet allows as much media to be open as possible. External or internal metal screens and perforated or expanded metal are not acceptable. The pulse cleaning system shall include the blow pipes, internal piping, compressed air header, solenoid valves, diaphragm valves. Only one cartridge shall be cleaned per tube sheet opening. Compressed air header may be either internal to clean plenum, or external, depending upon the application requirement. Compressed air will be supplied at 90-105 psig. Air will be clean, dry and oil free. The module(s) shall have capability for a top outlet designed for direct mounting a flanged, direct drive fan. The clean air plenum shall also have another outlet on the side for additional flexibility if a remote fan is used. Lifting lugs shall be provided.

H. The hopper section shall contain the hopper(s) and integral fabricated support legs. Hopper wall angle shall be sufficient to prevent dust build up and bridging of dust.

I. Support legs shall be designed to accommodate required dust discharge devices.

J. Provide silencer at outlet.

K. The unit parts shall be individually electrostatic powder painted, and once all parts are painted, the unit is fully assembled. There shall be no bare metal surfaces underneath any part of the unit.

L. Electrical enclosures shall be NEMA 4 for indoor use.

M. Cleaning cycle controls shall be available in microprocessor design which provides optimum cleaning operation. Control panel shall be remote mounted.

N. Secondary filter shall be supplied to provide recirculation air into the building. Safety filters shall be HEPA grade. Filter shall be mounted on top of the dust collector. Access to filters shall be via same platform used to access primary filters. Magnahelic gauge shall be included to monitor differential pressure of filters. Filters shall be installed prior to fan. Safety monitoring filter shall meet NFPA 69 and NFPA 654 as an effective flame-front arrestor for ST1 and ST2 dusts.

2.4 FAN

A. Fan shall have an entirely nonferrous wheel. Bearings shall not be placed in the air or gas stream. No part of fan shall strike any ferrous parts.

B. Motor: Permanently lubricated, explosion proof.

2.5 CONTROLS

A. Controller panel shall be NEMA 4X.

B. Integrated controller shall have factory programmed settings:
1. Pulse cleaning controls
2. Dirty filter pressure monitoring with digital display and alarms.
3. Motor starter with fuses and main disconnect
4. Start/stop buttons
5. Blower running lights.
6. Dust collector will be interlocked with the project dedicated outside air unit (DOAS). When the DOAS runs, the dust collector shall run.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for electrical connections to verify actual locations before dust collector installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install dust collector level and plumb.

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 238239.16

SECTION 23 55 23.13 - LOW-INTENSITY, GAS-FIRED, RADIANT HEATERS

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 low-intensity, gas-fired, forced-draft radiant heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Signed, sealed, and prepared by or under the supervision of a qualified professional engineer.
2. Include plans, elevations, sections, and mounting details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail fabrication and assembly of high-intensity, gas-fired, radiant heaters, as well as procedures and diagrams.
5. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Structural members to which equipment will be attached.
2. Gas piping to heater installations
3. Thermostats and wiring to heaters.
4. Heater locations and clearance requirements.
5. Other suspended ceiling components including the following:

a. Lighting fixtures.
b. Air outlets and inlets.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gas-fired, radiant heaters to include in emergency, operation, and maintenance manuals.

1.6 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. Igniter: One hot-surface burner igniter(s) for each style of high-intensity, gas-fired, radiant heater furnished.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period. Contractor shall guarantee all installed equipment, material, and work against

any defects in material or workmanship and shall satisfactorily correct, at no cost to the State, any such defect that may become apparent within a period of one year after completion of the installation.

1. Warranty Period: All warranty periods listed below are from date of Substantial Completion.

    a. Burner Assembly: Three years.
    b. Combustion and Emitter Tubes: Three years.
    c. Heater Controls: One year(s).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. CSA certified, with CSA Seal and certification number clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.

B. UL listed and labeled, with UL label clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 INFRARED RADIANT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Detroit Radiant Products Company.
2. Roberts-Gordon, Inc.
3. Superior Radiant Products Ltd.

B. Description: Factory-assembled, indoor or outdoor, overhead-mounted, electrically controlled, low-intensity, infrared radiant heating units using gas combustion. Heater to have all necessary factory-installed wiring and piping required prior to field installation and startup.

C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.

D. Burner Assembly:
1. Combustion-Air Inlet: Ducted vertical to outdoors through roof with vent caps.
2. Burner Control Housing: Stainless steel or corrosion-resistant, aluminized steel.

    a. Totally enclosed with stainless-steel access cover.
    b. Sight glass for visual inspection of burner.
    c. Finish: powder-coated finish.

3. Burner: Stainless steel.
4. Ignition System: Direct spark 115/120-V ac with flame rod sensing capabilities and self-diagnostic control module.
5. Combustion Blower Fan: Dynamically balanced, direct-driven, forward-curved fan with cast-aluminum-alloy or stainless-steel impeller and aluminized-steel housing, with a minimum temperature rating of 450 deg F.
6. Motors: General requirements for motors are specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

    a. Motor: Resilient-mounted, capacitor-start-capacitor-run type with sealed ball bearings; totally enclosed, nonventilated type with internal thermal protection.
    b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

E. Combustion Chamber: 4-inch-diameter, 16-gage, aluminized or titanium-coated aluminized-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish. Chambers shall be equipped with sight glass for burner and pilot flame observation.

F. Emitter Tube: 4-inch- diameter, 16-gage, aluminized or titanium-coated aluminized-steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish.

1. Tubing Connections: Compression couplings made from aluminized or stainless steel.
2. 90-degree-bend emitter steel tubing with high-emissivity, high-temperature, corrosion-resistant external finish.
3. Exhaust Vent Termination: Vertical through roof with vent caps.

G. Reflector: Polished stainless steel, with end caps. Shape to control radiation from tubing for uniform intensity at floor level with 100 percent cutoff above centerline of tubing. Reflectors or entire heater shall accommodate rotational adjustment from horizontal to a minimum 30-degree tilt from vertical.

H. Accessories:

1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation from tubing at angles greater than 30 degrees from vertical.
2. Stainless-steel flexible connector with manual valve for gas supply.
3. Hanger chain with "S" hooks.
4. 3/16-inch-diameter, aluminized-steel wire tubing hangers and reflector supports.
5. Rigid mounting kits.
6. Vent cap for flue and combustion air.
7. Vent adapter.
8. Clearance warning plaque.

2.3 CONTROLS AND SAFETIES

A. Gas Control Valve: Single-stage, regulated redundant 24-V ac gas valve that contains pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.

B. Failure Safeguards: 100 percent shutoff of gas flow in the event of flame or power failure.

C. Prepurge of 15 seconds of air control system prior to burner ignition.

D. Safety lockout of burner after three consecutive ignition failures.

E. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner operation with high discharge or suction pressure.

F. Control Panel Interlock: Stops burner if panel is open.

G. Indicator Lights: "Airflow-on" and"burner-on" indicator lights.

H. Thermostat: Single-stage, wall-mounted type with 50 to 90 deg F operating range and fan on switch.

1. Control Transformer: Integrally mounted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine structures, substrates, areas and conditions, with Installer present, for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance of the Work.

B. Examine roughing-in for fuel-gas piping to verify actual locations of piping connections before equipment installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Equipment Installation: Install gas-fired, radiant heaters and associated gas features and systems according to NFPA 54.

B. Suspended Units: Suspend from substrate using chain hanger kits and building attachments.
1. Comply with requirements for hangers and supports specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

C. Maintain manufacturers' recommended clearances for combustibles.

3.3 CONNECTIONS

A. Gas Piping: Comply with Section 23 11 23 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.

1. Gas Connections: Connect gas piping to radiant heaters according to NFPA 54.

B. Where installing piping adjacent to gas-fired, radiant heaters, allow space for service and maintenance.

C. Vent Connections: Comply with Section 23 31 13 "Metal Ducts" and with Section 23 51 23"Gas Vents."

D. Electrical Connections: Comply with applicable requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:

a. Test procedures used.
b. Test results that comply with requirements.
c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Gas-fired, radiant heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial-temperature set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.6 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain gas-fired, radiant heaters.

END OF SECTION

SECTION 23 74 33

DEDICATED OUTDOOR-AIR UNITS

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 factory-assembled, dedicated outdoor air-handling units, including multiple components, capable of heating and cooling 100 percent outdoor air.

1.3 DEFINITIONS:

A. ECM: Electronically commutated motor.

B. ISCOP: Integrated Seasonal Coefficient of Performance.

C. ISMRE: Integrated Seasonal Moisture Removal Efficiency.

D. MRC: Moisture Removal Capacity.

1.4 ACTION SUBMITTALS

A. Product Data: For each dedicated outdoor-air unit.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Include unit dimensions and weight.
4. Include cabinet material, metal thickness, finishes, insulation, and accessories.
5. Fans:

    a. Certified fan-performance curves with system operating conditions indicated.
    b. Certified fan-sound power ratings.
    c. Fan construction and accessories.
    d. Motor ratings, electrical characteristics, and motor accessories.

6. Include certified coil-performance ratings with system operating conditions indicated.
7. Include filters with performance characteristics.

8. Include heat exchangers with performance characteristics.
9. Include dampers, including housings, linkages, and operators.

B. Shop Drawings: For each dedicated outdoor-air unit.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor/roof plans and other details, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.

B. Sample Warranty: For manufacturer's warranty.

C. Product Certificates: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article and in Section 23 05 48 "Vibration and Seismic Controls for HVAC."

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Source quality-control reports.

E. Startup service reports.

F. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dedicated outdoor-air units to include in emergency, operation, and maintenance manuals.

1.7 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. Fan Belts: One set(**s**) for each belt-driven fan.
2. Filters: One set(**s**) for each unit.

3. Gaskets: One set(s) for each access door.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of dedicated outdoor air unit that fail in materials or workmanship within specified warranty period. Contractor shall guarantee all installed equipment, material, and work against any defects in material or workmanship and shall satisfactorily correct, at no cost to the State, any such defect that may become apparent within a period of one year after completion of the installation.

1. Warranty Period for Dedicated Outdoor-Air-Handling Units: One year from date of Substantial Completion.
2. Warranty Period for Compressors: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an "NRTL" (nationally recognized testing laboratory), and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of units and components.

C. ASHRAE 62.1 Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

D. ASHRAE 15 and ASHRAE 34 Compliance: For refrigeration system safety.

E. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

F. ASHRAE 84 Compliance: Comply with capacity ratings for heat-wheel energy-recovery equipment.

G. UL Compliance:

1. Electric Coils: Comply with requirements in UL 1995.

H. Wind-Restraint Performance:

1. See Section 23 05 48.13 "Vibration Controls for HVAC" for requirements.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AAON.
2. Daikin
3. Desert Aire.
4. Munters Corporation.

B. Source Limitations: Obtain dedicated outdoor-air units from single manufacturer.

2.3 UNIT CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Configuration: Horizontal unit with horizontal discharge for concrete-base installation.

C. Double-Wall Configuration:

1. Outside Casing Wall: Galvanized steel, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.
2. Inside Casing Wall:
   a. Inside Casing, All Other Sections: Galvanized steel.
   b. Antimicrobial Coating: Applied during the manufacturing process. Coating is to be NSF approved.

3. Floor Plate: Reinforced metal surface; reinforced to limit deflection when walked on by service personnel. Insulation is provided below metal walking surface.
4. Roof: Standing seam or membrane; sloped to drain water.
5. Casing Insulation:

    a. Materials: Polyurethane foam insulation.
    b. Casing Panel R-Value: Minimum R-13.
    c. Insulation Thickness: 4 inches.
    d. Thermal Break: Provide continuity of insulation with no through-casing metal in casing walls, floors, or roofs of air-handling unit.

D. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.

E. Panels and Doors:

1. Panels:

    a. Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
    b. Fasteners: Two or more camlock-type fasteners for panel lift-out operation. Arrangement shall allow panels to be opened against airflow
    c. Gasket: Neoprene, applied around entire perimeters of panel frames.
    d. Size: Large enough to allow unobstructed access for inspection and maintenance of unit's internal components

2. Doors:

    a. Fabrication: Formed and reinforced double-wall and insulated panels of same materials and thicknesses as casing.
    b. Hinges: A minimum of two ball-bearing hinges or stainless steel piano hinge and two wedge-lever latches, operable from inside and outside. Arrange doors to be opened against airflow. Provide safety latch retainers on doors so that doors do not open uncontrollably.
    c. Gasket: Neoprene, applied around entire perimeters of panel frames.
    d. Size: Large enough to allow for unobstructed access for inspection and maintenance of air-handling unit's internal components.

3. Locations and Applications:

    a. Fan Section: Doors.
    b. Access Section: Doors.
    c. Damper Section: Panels.
    d. Filter Section: Panels large enough to allow periodic removal and installation of filters.
    e. Relief Section: Doors.

F. Condensate Drain Pans:

1. Location: Each refrigerant coil.

2. Construction:

    a. Single-wall, stainless steel sheet.

3. Size: Large enough to collect condensate from cooling coils, including coil piping connections, coil headers, and return bends.
4. Drain Connection:

    a. Located on one end of pan, at lowest point of pan.
    b. Terminated with threaded nipple.
    c. Minimum Connection Size: NPS 1.

5. Slope: Minimum 0.125-inch/ft. slope, to comply with ASHRAE 62.1, in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and from humidifiers and to direct water toward drain connection.
6. Length: Extend drain pan downstream from leaving face for distance to comply with ASHRAE 62.1.
7. Width: Entire width of water-producing device.
8. Depth: A minimum of 2 inches deep.
9. Provide units having stacked coils with intermediate drain pan to collect condensate from top coil.

2.4 FANS, DRIVES, AND MOTORS

A. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.

B. Supply-Air Fans and Relief-Air Fans: Centrifugal; galvanized or painted steel; mounted on solid-steel shaft.

1. Shafts: With field-adjustable alignment.

    a. Turned, ground, and polished hot-rolled steel with keyway.

2. Shaft Bearings:

    a. Heavy-duty, self-aligning, pillow-block type with an L-50 rated life of minimum 100,000 hours in accordance with ABMA 9.

3. Housings: Formed- and reinforced-steel panels to form curved scroll housings with shaped cutoff and spun-metal inlet bell.

    a. Bracing: Steel angle or channel supports for mounting and supporting fan scroll, wheel, motor, and accessories.

4. Housings, Plenum Fans: Steel frame and panel; fabricated without fan scroll and volute housing. Provide inlet screens for Type SWSI fans.

5. Airfoil, Centrifugal Fan Wheels (Plenum Fan Wheels): Smooth-curved inlet flange, backplate, and hollow die-formed airfoil-shaped blades continuously welded at tip flange and backplate; steel hub riveted to backplate and fastened to shaft with setscrews.
6. Mounting: For internal vibration isolation. Factory mount fans with manufacturer's standard vibration isolation mounting devices having a minimum static deflection of 1 inch.
7. Shaft Lubrication Lines: Extended to a location outside the casing.
8. Flexible Connector: Factory fabricated with a fabric strip minimum 3-1/2 inches wide, attached to two strips of minimum 2-3/4-inch-wide by 0.028-inch-thick, galvanized-steel sheet.

    a. Flexible Connector Fabric: Glass fabric, double coated with neoprene. Fabrics, coatings, and adhesives shall comply with UL 181, Class 1.

C. Drive, Direct: Factory-mounted direct drive.

D. Condenser-Coil Fan: Variable-speed propeller, mounted on shaft of permanently lubricated electronically commutated motors.

E. Motors:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
2. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
3. Enclosure Type: Open, dripproof.
4. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
5. Mount unit-mounted disconnect switches on exterior of unit.

F. Comply with Section 26 29 23 "Variable-Frequency Motor Controllers."

G. Variable-Frequency Motor Controller:

1. Manufactured Units: Pulse-width modulated; constant torque and variable torque for inverter-duty motors.
2. Output Rating: Three phase; 10 to 60 Hz, with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
3. Unit Operating Requirements:

    a. Internal Adjustability:

        1) Minimum Speed: 5 to 25 percent of maximum rpm.
        2) Maximum Speed: 80 to 100 percent of maximum rpm.
        3) Acceleration: 0.1 to 999.9 seconds.
        4) Deceleration: 0.1 to 999.9 seconds.
        5) Current Limit: 30 to minimum of 150 percent of maximum rating.

    b. Self-Protection and Reliability Features:

1) Surge suppression.
2) Loss of input signal protection.
3) Under- and overvoltage trips.
4) Variable-frequency motor controller and motor-overload/overtemperature protection.
5) Critical frequency rejection.
6) Loss-of-phase protection.
7) Reverse-phase protection.
8) Motor-overtemperature fault.

c. Bidirectional autospeed search.
d. Torque boost.
e. Motor temperature compensation at slow speeds.

1) Panel-mounted operator station.
2) Historical logging information and displays.
3) Digital indicating devices.

f. Control Signal Interface: Electric.
g. Proportional Integral Directive (PID) control interface.

4. Line Conditioning:

a. Input line conditioning.
b. Output filtering.
c. EMI/RFI filtering.

2.5 COILS

A. General Requirements for Coils:

1. Comply with AHRI 410.
2. Fabricate coils section to allow removal and replacement of coil for maintenance and to allow in-place access for service and maintenance of coil(s).
3. Coils are not to act as structural component of unit.

B. Supply-Air Refrigerant Coils:

1. Tubes: Copper.
2. Fins:

a. Material: Aluminum.
b. Fin Spacing: Maximum 14 fins per inch.

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Coatings: None.
7. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.

a. Working Pressure: Minimum 300 psig.

C. Hot-Gas Reheat Refrigerant Coils:

1. Tubes: Copper.
2. Fins:

a. Material: Aluminum.
b. Fin Spacing: Maximum 12 fins per inch.

3. Fin and Tube Joints: Mechanical bond.
4. Headers: Seamless-copper headers with brazed connections.
5. Frames: Galvanized steel.
6. Coatings: None.
7. Ratings: Designed, tested, and rated in accordance with ASHRAE 33 and AHRI 410.

a. Working Pressure: Minimum 300 psig.

8. Coating: None.
9. Suction-discharge bypass valve.

D. Electric-Resistance Heating Coils: Comply with UL 1995.

1. Casing Assembly: Slip-in type with galvanized-steel frame.
2. Open Heating Elements: Resistance wire of 80 percent nickel and 20 percent chromium supported and insulated by floating ceramic bushings recessed into casing openings, fastened to supporting brackets, and mounted in galvanized-steel frame.
3. Overtemperature Protection: Disk-type, automatically resetting, thermal-cutout, safety device; serviceable through terminal box without removing heater from coil section.
4. Secondary Protection: Load-carrying, manually resetting or manually replaceable, thermal cutouts; factory wired in series with each heater stage.
5. Control Panel: Unit mounted with disconnecting means and overcurrent protection.

a. Magnetic contactor.
b. Solid-state, stepless pulse controller.
c. Toggle switches, one per step.
d. SCRcontroller.
e. Time-delay relay.
f. Pilot lights, one per step.
g. Airflow proving switch.

2.6 REFRIGERATION CIRCUIT COMPONENTS

A. Compressors: Hermetic, variable-speed scroll compressors, mounted on integral vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

B. Refrigerant: R-410A.

C. Refrigeration Specialties:

1. Expansion valve with replaceable thermostatic element.
2. Refrigerant filter/dryer.
3. Manual-reset high-pressure safety switch.
4. Automatic-reset low-pressure safety switch.
5. Minimum off-time relay.
6. Automatic-reset compressor motor thermal overload.
7. Thermostat for coil freeze-up protection during low-ambient-temperature operation or loss of air.
8. Brass service valves installed in discharge and liquid lines.
9. Low-ambient kit high-pressure sensor.
10. Single compressor with evaporator and condenser coil within the refrigerant section to provide initial pre-cooling and to reheat for humidity control.
11. Modulating hot-gas reheat solenoid valve with a replaceable magnetic coil.
12. Heat-pipe heat exchanger, wrapped around the evaporator coil to pre-cool the air entering the evaporator coil and reheat the air leaving the evaporator coil to control humidity.
13. Hot-gas bypass refrigerant control for capacity control with continuous dehumidification for single-speed compressor.

2.7 AIR FILTRATION

A. Particulate air filtration is specified in Section 23 41 00 "Particulate Air Filtration."

B. Panel Filters:

1. Description: Pleated factory-fabricated, self-supported disposable air filters with holding frames.
2. Filter Unit Class: UL 900.
3. Media: Interlaced glass, synthetic, or cotton fibers coated with nonflammable adhesive and antimicrobial coating.
4. Filter-Media Frame: High wet-strength beverage board with perforated metal retainer, or metal grid, on outlet side.

C. Mounting Frames:

1. Panel filters arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or from access plenum.
2. Cartridge filters arranged for flat orientation, removable from access plenum.
3. Galvanized or stainless steel with gaskets and fasteners, suitable for bolting together into built-up filter banks.

2.8 ROTARY HEAT EXCHANGER

A. Casing:

1. Galvanized steel, stainless steel, or aluminum with manufacturer's standard factory-painted finish.

2. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
3. Casing seals on periphery of rotor and on duct divider and purge section.
4. Support vertical rotor on grease-lubricated ball bearings having extended grease fittings or permanently lubricated bearings. Support horizontal rotors on tapered roller bearings.

B. Rotor - Aluminum, Metallic, or Polymer: Aluminum, metallic, or polymer segmented wheel, strengthened with radial spokes impregnated with nonmigrating, water-selective, molecular-sieve desiccant coating.

C. Drive: Fractional horsepower motor and gear reducer, with speed changed by variable-frequency controller. Provide permanently lubricated wheel bearings.

D. Controls:

1. Starting relay, factory mounted and wired, and manual motor starter for field wiring.
2. Variable-frequency controller, factory mounted and wired, permitting input of 4-20 mA or 1-10 V control signal.
3. Control energy recovery to permit air economizer operation.

    a. Bypass dampers to assist energy recovery control.

4. Pilot-Light Indicator: Display rotor rotation and speed.
5. Speed Settings: Adjustable settings for maximum and minimum rotor speed limits.
6. Integral purge section limiting carryover of exhaust air to between 0.05 percent at 1.6-inch wg and 0.20 percent at 4-inch wg differential pressure.
7. Defrost cycle.

2.9 DAMPERS

A. Outdoor- and Relief-Air Dampers: Low-leakage, double-skin, airfoil-blade, galvanized-steel dampers with compressible jamb seals and extruded-vinyl blade edge seals in parallel-blade arrangement with zinc-plated steel operating rods rotating in sintered bronze or nylon bearings mounted in a single galvanized-steel frame, and with operating rods connected with a common linkage. Leakage rate shall not exceed 4 cfm/sq. ft. at 1 inch wg and 8 cfm/sq. ft. at 4 inches wg.

B. Electronic Damper Operators:

1. Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
2. Electronic damper position indicator shall have visual scale indicating percentage of travel and 2 to 10 V dc feedback signal.
3. Operator Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
    b. Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.

c. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.

4. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
5. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.
6. Coupling: V-bolt and V-shaped, toothed cradle.
7. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
8. Fail-Safe Operation: Mechanical, spring-return mechanism with external, manual gear release on nonspring-return actuators.

2.10 ACCESSORIES

A. Low-ambient kit using variable-speed condenser fans for operation down to 35 deg F.

B. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

C. Remote potentiometer to adjust minimum economizer damper position.

D. Return-air bypass damper.

E. Factory- or field-installed demand-controlled ventilation.

F. Safeties:

1. Smoke detector in outside air and exhaust.
2. Condensate overflow switch.
3. Phase-loss protection.
4. High and low pressure control.
5. Electric coil airflow-proving switch.

G. Coil guards of painted, galvanized-steel wire.

H. Hail guards of galvanized steel, painted to match casing.

I. Door switches to disable heating or reset set point when open.

J. Outdoor air intake weather hood.

2.11 ELECTRICAL POWER CONNECTIONS

A. Single-Point Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other necessary electrical devices shall provide a single-point field power

connection to unit except for service lights and convenience outlets, which are to be powered separately.

B. Enclosure: NEMA 250, Type 3R, mounted in unit with hinged access door in unit cabinet having a lock and key or padlock and key.

C. Wiring: Numbered and color-coded to match wiring diagram.

D. Wiring Location: Install factory wiring outside an enclosure in a raceway.

E. Power Interface: Field power interface to be NEMA KS 1, heavy-duty, nonfused disconnect switch.

F. Factory Wiring: Branch power circuit to each motor and to controls with one of the following disconnecting means:

1. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection in accordance with IEC 60947-4-1.
2. NEMA KS 1, heavy-duty, nonfusible switch.
3. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

G. Factory-Mounted, Overcurrent-Protection Service: For each motor.

H. Transformer: Factory mounted with primary and secondary fuses and sized with enough capacity to operate electrical load plus spare capacity.

I. Controls: Factory wire unit-mounted controls where indicated.

1. Service Lights: LED vaporproof luminaire with individual switched junction box located inside, adjacent to each access door and panel.

a. Locations: Each section accessed with door or panel.

2. Convenience Outlets: One 20 A duplex GFCI receptacle per location with junction box located on outside casing wall.

a. Locations: Fan section.

J. Control Relays: Auxiliary and adjustable time-delay relays.

2.12 CONTROLS

A. Control Wiring: Factory wire connection for controls' power supply.

B. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

C. Unit-Mounted Status Panel:

1. Cooling/Off/Heating Controls: Control operational mode.
2. Damper Position: Indicate position of outdoor-air dampers in terms of percentage of outdoor air.
3. Safety Control Operation:

    a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire-alarm control panel.
    b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg enters unit. Provide additional contacts for alarm interface to fire-alarm control panel.

4.
5. Status Lights:

    a. Filter dirty.
    b. Fan operating.
    c. Cooling operating.
    d. Heating operating.
    e. Smoke alarm.
    f. General alarm.

6. Digital Numeric Display:

    a. Outdoor airflow.
    b. Supply airflow.
    c. Outdoor dry-bulb temperature.
    d. Outdoor dew point temperature.
    e. Space temperature.
    f. Supply temperature.
    g. Space relative humidity.

D. Refrigeration System Controls:

1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F.
2. Outdoor-air sensor de-energizes dehumidifier operation when outdoor-air temperature is less than 60 deg F.
3. Relative-humidity sensor energizes dehumidifier operation when relative humidity is more than 50 percent.

E. Rotary Heat-Exchanger Control:

1. Sequence with refrigeration system controls and heating controls.
2. For operation of rotary heat exchanger itself, see "Rotary Heat Exchanger" Article.

F. Electric-Resistance Heat Controls:

1. Factory-mounted sensor in unit discharge with sensor adjustment located in control panel to control electric coil to maintain temperature.
2. Capacity Controls: Modulating SCR.

G. Damper Controls: Space-pressure sensor modulates outdoor- and relief-air dampers to maintain a positive pressure in space at a minimum of 0.05 inch wg with respect to outdoor reference.

2.13 INTAKE AND RELIEF OPENINGS

A. Type: Manufacturer's standard hood or louver, including moisture eliminator, at all unit intake and relief openings.

B. Materials: Match material and finish of casing exterior.

C. Bird Screen: Comply with requirements in ASHRAE 62.1.

D. Configuration: Designed to inhibit wind-driven rain and snow from entering unit.

2.14 MATERIALS

A. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for steel sheet.

B. Stainless Steel:

1. Manufacturer's standard grade for casing.
2. Manufacturer's standard type, ASTM A240/A240M for bare steel exposed to airstream or moisture.

C. Galvanized Steel: ASTM A653/A653M.

D. Aluminum: ASTM B209.

2.15 SOURCE QUALITY CONTROL

A. AHRI 920: Manufacturer to certify that performance ratings are in accordance with AHRI 920 if AHRI 920 certification program is not in place. Provide AHRI 920 certification if AHRI 920 certification program is in place.

B. AHRI 260 or AMCA 311 Sound Performance Rating Certification: Test, rate, and label unit fan sound ratings in accordance with AHRI 260 or AMCA 311.

C. Fan Aerodynamic Performance Rating: Test and rate fan performance for airflow, pressure, power, air density, rotation speed, and efficiency.

1. Fan Aerodynamic Performance Rating: Test and rate fan performance in accordance with AMCA 210.
2. AMCA Fan Aerodynamic Certification Rating: Test, rate, and label, in accordance with AMCA 211.

D. Fan Energy Index (FEI): Test in accordance with AMCA 210 and rate in accordance with AMCA 99, AMCA 207, and AMCA 208.

E. Fan Operating Limits: Classify fans in accordance with AMCA 99, Section 14.

F. Damper Leakage and Air Performance:

1. Damper Rating: Test and rate dampers for leakage and air performance in accordance with AMCA 510.
2. AMCA Damper Certification: Test, rate, and label in accordance with AMCA 511.

G. Refrigerant Coils: Factory tested to minimum 300 psig internal pressure and to minimum 300 psig internal pressure while under water, in accordance with AHRI 410 and ASHRAE 33.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Unit Support: Install unit level on structural curbs. Coordinate roof penetrations and flashing with roof construction. Secure units to structural support with anchor bolts. Coordinate sizes and locations of curbs with actual equipment provided.

B. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with new, clean filters.

C. 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. Provide filter gauges on filter banks, installed with separate static-pressure taps upstream and downstream of filters.

D. Connect duct to air-handling units with flexible connections. Comply with requirements in Section 23 33 00 "Air Duct Accessories."

E. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

F. Install separate devices furnished by manufacturer and not factory installed.

G. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 PIPING CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to units, allow space for service and maintenance.

C. Connect piping to units mounted on vibration isolators with flexible connectors.

D. Refrigerant Piping: Comply with applicable requirements in Section 23 23 00 "Refrigerant Piping." Install shutoff valve and union or flange at each supply and return connection.

E. Duct Connections:

1. Comply with requirements in Section 23 31 13 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 23 33 00 "Air Duct Accessories."

3.4 ELECTRICAL CONNECTIONS

A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."

C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 26 05 53 "Identification for Electrical Systems."
2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

A. Install control and electrical power wiring to field-mounted control devices.

B. Connect control wiring in accordance with Section 26 05 23 "Control-Voltage Electrical Power Cables."

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks in accordance with manufacturer's written instructions.

2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
3. Start refrigeration system when outdoor-air temperature is within normal operating limits. and measure and record the following:

    a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
    b. Cooling coil entering-air, dry- and wet-bulb temperatures.
    c. Condenser coil entering-air dry-bulb temperature.
    d. Condenser coil leaving-air dry-bulb temperature.

4. Simulate maximum cooling demand and inspect the following:

    a. Compressor refrigerant suction and hot-gas pressures.
    b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.

5. Inspect casing insulation for integrity, moisture content, and adhesion.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean coils and inspect for construction debris.
10. Verify bearing lubrication.
11. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Start unit.
13. Inspect and record performance of interlocks and protective devices, including response to smoke detectors by fan controls and fire alarm.
14. Operate unit for run-in period.
15. Calibrate controls.
16. Adjust and inspect high-temperature limits.
17. Inspect outdoor-air dampers for proper stroke.
18. Verify operational sequence of controls.
19. Measure and record the following airflows. Plot fan volumes on fan curve.

    a. Supply-air volume.
    b. Relief-air flow.
    c. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate, and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.7 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 CLEANING

A. After completing system installation; testing, adjusting, and balancing dedicated outdoor-air unit and air-distribution systems; and completing startup service, clean air-handling units internally to remove foreign material and construction dirt and dust. Clean fan wheels, casings, dampers, coils, and filter housings, and install new, clean filters.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, fill water and steam coils with water, and test coils and connections for leaks.
2. Charge refrigerant coils with refrigerant and test for leaks.
3. Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 23 81 26

SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 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. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - " Procedures," and Section 7 - "Construction and System Start-up."

C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

D. ARI 210/240.

E. UL listed.

F. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

G. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

H. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period. Contractor shall guarantee all installed equipment, material, and work against any defects in material or workmanship and shall satisfactorily correct, at no cost to the State, any such defect that may become apparent within a period of one year after completion of the installation.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation.
2. Lennox Industries, Inc.; Lennox International.
3. LG Air Conditioning Technologies
4. Mitsubishi Electric & Electronics USA, Inc.
5. Samsung HVAC.
6. Trane.

2.2 INDOOR UNITS (5 TONS OR LESS)

A. Multi Zone Vertical Air Handling Unit:

1. Chassis: Vertical air handling unit. Galvanized steel with flanged edges, removable panels for servicing. 22 gauge metal and finished with baked enamel finish. Cold surfaces of unit are covered internally with ½ inch polystyrene fiber insulation; inside surface of the pan assembly door access panel is treated with ½ inch polystyrene fiber insulation, encapsulated on both sides. The access panel is sealed along the edges with reinforced foil faced covering, all access panels also have gasket seals to minimize air leaks.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110. Each unit has minimum of two rows of coils, pressure tested at the factory.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Forward-curved electronically commutated motor, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Filters: MERV 8.
8. Provide smoke detector in unit. Smoke detector shall be mounted on return duct and shall be able to shut down unit if smoke is detected.
9. Control: indoor unit is provided with integral control board to communicate with outdoor unit.
10. Condensate Drain Pans:

    a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        2) Depth: A minimum of 2 inches deep.

    b. Single-wall, stainless-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

        1) Minimum Connection Size: NPS 3/4.

B. Single Zone Vertical Air Handling Unit:

1. Chassis: Vertical air handling unit. Galvanized steel with flanged edges, removable panels for servicing. 22 gauge metal and finished with baked enamel finish. Cold surfaces of unit are covered internally with ½ inch polystyrene fiber insulation; inside surface of the pan assembly door access panel is treated with ½ inch polystyrene fiber insulation, encapsulated on both sides. The access panel is sealed along the edges with reinforced foil faced covering, all access panels also have gasket seals to minimize air leaks.

2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110. Each unit has minimum of two rows of coils, pressure tested at the factory.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Forward-curved electronically commutated motor, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Wiring Terminations: Connect motor to chassis wiring with plug connection.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Filters: MERV 8.
8. Provide smoke detector in unit. Smoke detector shall be mounted on return duct and shall be able to shut down unit if smoke is detected.
9. Condensate Drain Pans:

    a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        2) Depth: A minimum of 2 inches deep.

    b. Single-wall, stainless-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

        1) Minimum Connection Size: NPS 3/4.

C. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Heavy duty acrylonitrile butadiene styrene and high impact polystyrene plastic with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Fan: Direct drive.
4. Fan Motors:

a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
c. Enclosure Type: Totally enclosed, fan cooled.
d. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
6. Condensate Drain Pans:

a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

7. Air Filtration Section:

a. General Requirements for Air Filtration Section:

1) Comply with NFPA 90A.
2) Minimum MERV according to ASHRAE 52.2.
3) Filters: Permanent, cleanable.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Multi-Zone Air-Cooled, Compressor-Condenser Components (Heat pump HP-1, HP-2, HP-8):

1. Casing: Steel, finished with pre-coated metal (PCM) with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Provide integral coil guard.
3. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

a. Compressor Type: Scroll.
b. Inverter driven twin rotary compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant: R-410A.
d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

4. Heat-Pump Components: Refrigerant strainer, four-way reversing valve, electronic controlled expansion valve, high and low side charging ports, service valves, oil separator, subcooler and interconnecting piping.
5. Fan: Variable speed, axial flow fans, directly connected to motor.

6. Motor: Permanently lubricated, with integral thermal-overload protection. Brushless digitally controlled fan motor.
7. Factory mounted outdoor unit controls.
8. Low Ambient Kit: Permits operation down to -10 deg F.
9. Hail guards: Galvanized steel guard with top hood sloped away from condenser coil.
10. Mounting Base: Polyethylene.
11. Raised guards.
12. Multi zone split condensing system that can connect multiple indoor units to a single condensing unit. Refer to split system schedule for number of indoor units for each condensing unit.
13. Drain pan heater.

B. Single Zone Air-Cooled, Compressor-Condenser Components (Heat pump):

1. Casing: Steel, finished with pre-coated metal (PCM) with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Provide integral coil guard.
3. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Inverter driven twin rotary compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant: R-410A.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

4. Heat-Pump Components: Refrigerant strainer, four-way reversing valve, electronic controlled expansion valve, high and low side charging ports, oil separator service valves.
5. Fan: Variable speed, propeller type, directly connected to motor.
6. Motor: Permanently lubricated, with integral thermal-overload protection. Brushless digitally controlled fan motor.
7. Low Ambient Kit: Permits operation down to -10 deg F.
8. Mounting Base: Polyethylene.
9. Hail guards: Galvanized steel guard with top hood sloped away from condenser coil.
10. Raised guards.
11. Drain pan heater.

C. Air-Cooled, Compressor-Condenser Components (Cooling Only):

1. Casing: Steel, finished with pre-coated metal (PCM) with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Provide integral coil guard.
3. Unit shall be Multi-zone system type. Up to three indoor units can be connected to outdoor unit.

4. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll.
    b. Inverter driven twin rotary compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant: R-410A.
    d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

5. Fan: Variable speed, propeller type, directly connected to motor.
6. Outdoor unit shall be provided with refrigerant strainer, check valves, oil separator, accumulator, electronic expansion valve, high side and low side refrigerant charging ports and a service port.
7. Outdoor unit shall also include sensors for suction temperature, discharge temperature, high-pressure low-pressure, heat exchanger temperature, and outdoor temperature conditions. Unit shall have oil injection system.
8. Motor: Permanently lubricated, with integral thermal-overload protection. Brushless digitally controlled fan motor.
9. Mounting Base: Polyethylene.
10. Raised guards.
11. Hail guards: Galvanized steel guard with top hood sloped away from condenser coil.
12. Drain pan heater.

2.4 ACCESSORIES

A. Thermostat: Manufacturer wired controller remotely control compressor and evaporator fan, with the following features:

    1. Compressor time delay.
    2. 24-hour time control of system stop and start.
    3. Auto changeover.
    4. Auto restart operation.
    5. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
    6. Fan-speed selection including auto setting.
    7. Airflow direction.
    8. Static pressure.
    9. Room temperature sensing location.
    10. Cooling, heating, dehumidifying, fan only and auto mode.
    11. Thermostat display shall be able to be locked and display disabled as to not allow building occupants to adjust temperature.

B. Automatic-reset timer to prevent rapid cycling of compressor.

C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

D. Drain Hose: For condensate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:

1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
2. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
3. Comply with requirements for vibration isolation devices specified in Section 23 05 48.13 "Vibration Controls for HVAC."

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

E. For split systems, Contractor shall provide layout of shop drawing of refrigerant piping to manufacturer for sizing prior to installing piping. All pipe sizes shall be approved by equipment manufacturer.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 23 31 13 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and return ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 23 33 00 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 23 82 39.16

PROPELLER UNIT HEATERS

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 propeller unit heaters with electric-resistance heating coils.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. PTFE: Polytetrafluoroethylene plastic.

C. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include location and size of each field connection.
4. Include details of anchorages and attachments to structure and to supported equipment.
5. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
6. Indicate location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training. All HVAC work shall be performed by an air conditioning contractor holding a current Class A or B air conditioning license as issued by the Texas Department of Licensing and Regulation.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. All materials and equipment containing asbestos are prohibited. Contractor shall provide certification.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of equipment that fail in materials or workmanship within specified warranty period. Contractor shall guarantee all installed equipment, material, and work against any defects in material or workmanship and shall satisfactorily correct, at no cost to the State, any such defect that may become apparent within a period of one year after completion of the installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chromalox
2. Modine
3. QMark – Marley Engineered Products

2.2 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in vertical and horizontal discharge configuration with adjustable discharge louvers.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 2021.

D. Comply with UL 823.

2.3 PERFORMANCE REQUIREMENTS

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

B. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

2.4 HOUSINGS

A. Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heaters before shipping.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.5 COILS

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.
2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.6 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated, explosion proof. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

2.7 CONTROLS

A. Control Devices:

1. Unit-mounted, fan-speed switch.
2. Unit-mounted thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust initial temperature set points.

END OF SECTION

SECTION 26 00 00

DIVISION 26 SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

B. Related Requirements:

1. Division 01 Section "Submittal Procedures" for coordinating Division 26 submittals with other Divisions.
2. Division 01 Section "Operation and Maintenance Data" for submitting operation and maintenance manuals.
3. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Division 01 Section "Demonstration and Training" for training of Owner's personnel.

1.3 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Engineer's and Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's and Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and Architect and additional time for handling and reviewing submittals required by those corrections. Inadequate lead times will not be reason for approval of submittal.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Engineer's Digital Data Files: Electronic digital data of the Revit model used to produce the Contract Drawings will be provided by Engineer for Contractor's use in preparing submittals only after Engineer's Release Form has been appropriately executed.

1. Engineer will furnish Contractor one set of digital data files used to produce the Contract Drawings for use in preparing Shop Drawings and Project record drawings.

    a. Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Contract Drawings.
    b. Digital Drawing Software Program: The Contract Drawings are available in Autodesk Revit 2013.
    c. Contractor shall execute a data licensing agreement (Engineer's Release Form) in substantial agreement with AIA Document C106, Digital Data Licensing Agreement.
    d. The Contractor agrees as a pre-condition of the use of Engineer's digital data files to provide Engineer with Contractor's final files (Record Drawings) at the completion of the project in the same software version as provided by Engineer.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all submittal items required for Division 26 Sections concurrently unless partial submittals are indicated on approved submittal schedule. Product data submittals and shop drawings may be submitted in separate volumes.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Engineer and Architect reserve the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

5. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer and Architect will advise Contractor when a submittal being processed must be delayed for coordination.
6. Resubmittal Review: One resubmittal is allowed. Additional resubmittal reviews will be performed after Engineer's review fees have been negotiated. Allow 15 days for review of each resubmittal.

C. Paper Submittals: Paper submittals are not permitted.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

    a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-231000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-231000.01.A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Engineer and Architect.
4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner and Architect, containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Engineer.
    d. Name of Architect.
    e. Name of Contractor.
    f. Name of firm or entity that prepared submittal.
    g. Names of subcontractor, manufacturer, and supplier.
    h. Category and type of submittal.
    i. Submittal purpose and description.
    j. Specification Section number and title.
    k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    l. Drawing number and detail references, as appropriate.
    m. Location(s) where product is to be installed, as appropriate.
    n. Related physical samples submitted directly.
    o. Indication of full or partial submittal.
    p. Transmittal number, numbered consecutively.
    q. Submittal and transmittal distribution record.
    r. Other necessary identification.
    s. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:

a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.

6. Options: Clearly identify each option requiring selection by Contractor.

E. Options: Identify options requiring selection by Engineer.

F. Additional Information: Prepare on Contractor's letterhead, relevant information, requests for data, revisions other than those requested by Engineer on previous submittals. Include same identification information as related submittal.

G. Deviations: During the submittal process, deviations from the contract documents will not be allowed. If deviations are included in submittals but not specifically noted, deviation will not be allowed, even if submittal is approved without exception.

H. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's and Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by Division 26 Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Submit electronic submittals via email or directly to Project Web site as PDF electronic files.

a. Engineer, through Architect, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

B. Product Data:

1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.

3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's product specifications.
    c. Standard color charts.
    d. Statement of compliance with specified referenced standards.
    e. Testing by recognized testing agency.
    f. Application of testing agency labels and seals.
    g. Notation of coordination requirements.
    h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Schedules.
    c. Compliance with specified standards.
    d. Notation of coordination requirements.
    e. Notation of dimensions established by field measurement.
    f. Relationship and attachment to adjoining construction clearly indicated.
    g. Seal and signature of professional engineer if specified.

2. BIM (Revit) File Incorporation: Develop and incorporate Shop Drawing files into Building Information Model established for Project.

D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.

E. Coordination Drawing Submittals: Comply with requirements specified in Division 01 Section "Project Management and Coordination."

F. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."

G. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."

H. LEED Submittals: Comply with requirements specified in Division 01 sustainable design requirements Section.

I. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of Engineers and owners, and other information specified.

J. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

K. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

L. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

M. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

N. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

O. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

P. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

Q. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.

6. Test procedures and results.
7. Limitations of use.

R. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

S. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

T. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer and Architect.

B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 ENGINEER'S ACTION

A. Action Submittals: Engineer will review each submittal, make marks to indicate corrections or revisions required, and return it. Engineer will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:

1. Engineer’s Review
   a. No Exceptions Taken: Engineer’s review found no apparent discrepancies between submittal data and requirements of Contract Documents. No further submittal review action required from Contractor.
   b. Accepted as Noted: Engineer’s review found the submittal to be in substantial conformance with the requirements of Contract Documents.
   c. Rejected: Engineer’s review found the submittal to be in non-conformance with the requirements of Contract Documents.
2. Responses required by Contractor:

a. Confirm: Contractor will review Engineer's notations on submittal and confirm via written response the information requested by Engineer
b. Revise: Contractor will review Engineer's notations on submittal and revise submittal to comply.
c. Resubmit: Contractor will make changes to submittal in accordance with Engineer's notations and resubmit complete section.

3. Additional Requirements:
   a. Requires Review and Approval by _____: In addition to Engineer's review of submittal, the submittal must be officially submitted and approved by the authority/consultant noted.

B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements.

C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer and Architect.

D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

E. Submittals not required by the Contract Documents may be returned by the Engineer without action.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Subject to compliance with requirements, provide product by one of the following:
1. Alpha Wire.
2. Encore Wire Corporation.
3. General Cable Technologies Corporation.

4. Southwire Incorporated.
5. Senator Wire & Cable Company

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THW-2, Type THHN-2-, THWN-2 or Type XHHW-2.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC with ground wire in lengths not over 6 ft.

2.2 CONNECTORS AND SPLICES

A. Subject to compliance with requirements, provide product by one of the following:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. O-Z/Gedney; a brand of the EGS Electrical Group.
7. 3M; Electrical Markets Division.

B. Description: Factory-fabricated connectors size, ampacity rating, material, type, and class for application and service indicated.

C. All conductors and cable shall not be spliced. All splices found in field shall be corrected by contractor at contractors expense.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 and No. 12 AWG and smaller; stranded for No. 8 and No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

E. Feeders Installed below Raised Flooring: Type THHN-2-THWN-2, single conductors in raceway.

F. Feeders in Cable Tray: Type THHN-2-THWN-2, single conductors or Type XHHW-2, single conductors larger than No. 1/0 AWG.

G. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway or Type XHHW-2, single conductors in raceway.

J. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

K. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. 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-486B.

B. Make terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation rating..

1. Use oxide inhibitor in each termination and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Color-code conductors per TxDOT design guidelines. Coordinate with local AHJ for approved color-codes and notify TxDOT and engineer of record of any discrepancies. Color shall be factory applied. Color-Code conductors as follows:

1. Conductor sizes #10AWG and smaller:
    a. Black, red, and blue for 208/120 Volts, single or three phase, wye systems.
    b. Purple, brown, and yellow for circuits at 480/277 Volts, single or three phase, wye systems.
    c. Black for “A” leg and red for “B” leg for circuits at 120/240 Volt single phase.
    d. Black and red for the non-high-leg phases and orange for the high-leg phase for circuits at 120/240 Volt, three phase, open-delta.

2. Conductor sizes #8AWG and larger:
    a. Black, red, and blue for 208/120 Volts, single or three phase, wye systems.
    b. Purple, brown, and yellow for circuits at 480/277 Volts, single or three phase, wye systems.
    c. Black for “A” leg and red for “B” leg for circuits at 120/240 Volt single phase.
    d. Black and red for the non-high-leg phases and orange for the high-leg phase for circuits at 120/240 Volt, three phase, open-delta.
3. Neutral Conductors: White or gray. If two neutral conductors are routed in one conduit, install one white conductor and one gray conductor. Identify each with the proper circuit number. If more than two neutrals are in one conduit, individually identify each with the proper circuit numbers.

C. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.

    a. Standby Generator

    b. Automatic Transfer Switches

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.
3. Ground rings.
4. Grounding arrangements and connections for separately derived systems.
5. Ground Cable.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. Dossert; AFL Telecommunications LLC.
3. ERICO International Corporation.
4. Fushi Copperweld Inc.
5. Galvan Industries, Inc.; Electrical Products Division, LLC.
6. Harger Lightning and Grounding.
7. ILSCO.
8. O-Z/Gedney; A Brand of the EGS Electrical Group.
9. Robbins Lightning, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section length as indicated on drawings, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad Zinc-coated Stainless steel, sectional type; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

B. Transformers: Install grounding conductor to building steel in accordance with NFPA 70. The conductor shall be connected to the equipment grounding lug and to the enclosure of the transformer.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 26 05 43 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.

1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
2. Bury ground ring not less than 24 inches from building's foundation.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.
7. Maximum ground resistance at any point within the electrical system shall not exceed 15 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.
2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Nonmetallic slotted channel systems. Include Product Data for components.
4. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 07 72 00 "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit.
b. Cooper B-Line, Inc.
c. ERICO International Corporation.

d. GS Metals Corp.
e. Thomas & Betts Corporation.
f. Unistrut; Atkore International.
g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
5. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Cooper B-Line, Inc.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti, Inc.
      4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.
7. Powder-Actuated Fasteners are not permitted.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 05 50 00 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 Spring-tension clamps.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 50 00 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi, 28-day compressive-strength concrete. Refer to Concrete materials, reinforcement, and placement requirements as specified in Section 03 30 00 "Cast-in-Place Concrete." Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Touchup: Comply with requirements in Section 09 91 13 "Exterior Painting" Section 09 91 23 "Interior Painting" and Section 09 96 00 "High Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney.
6. Picoma Industries.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. FMC: Comply with UL 1; zinc-coated steel.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.

b. Type: Compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corporation.
6. Condux International, Inc.
7. Electri-Flex Company.
8. Kraloy.
9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; Hubbell.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

D. LFNC: Comply with UL 1660.

E. Rigid HDPE: Comply with UL 651A.

F. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

G. Fittings for LFNC: Comply with UL 514B.

H. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Mono-Systems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R Type 4 Type 12 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman.
7. Hubbell Incorporated.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney.
12. RACO; Hubbell.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

M. Gangable boxes are allowed provided devices are de-rated per manufacturer’s requirements.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R Type 4 Type 12 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 Type 3R Type 12 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Armorcast Products Company.
   b. Carson Industries LLC.
   c. NewBasis.
   d. Oldcastle Precast, Inc.
   e. Quazite: Hubbell Power System, Inc.
   f. Synertech Moulded Products.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with integral closed bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC." or “COMMUNICATIONS” to match the type of cabling installed.
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes Minimum 12 Inches Wide by 24 Inches Long unless noted otherwise on plans. Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Use the following wiring methods:
1. Exposed: PVC rigid conduit.
2. Concealed: PVC rigid conduit.
3. Underground, Single Run: PVC rigid conduit, with GRC elbows and risers encased in concrete for 3” conduit and larger.
4. Underground, Grouped: PVC rigid conduit, with GRC elbows and risers encased in concrete for 3” conduit and larger.
5. Service Entrance, Underground, Grouped: PVC rigid conduit, concrete encased, with GRC elbows and risers.
6. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment: liquidtight flexible metal conduit.
7. Indoors or Outdoors: Connection to vibrating equipment and hydraulic, pneumatic, or electric solenoid or motor-driven equipment in moist or humid location or corrosive atmosphere, or where subject to water spray or dripping oil, grease, or water: liquidtight flexible metal conduit.

B. Indoors: Use the following wiring methods:
1. Connection to Vibrating Equipment: Including transformers and hydraulic, pneumatic or electric solenoid or motor-operated equipment: flexible metal conduit.
2. Exposed: electrical metallic tubing.
3. Concealed: electrical metallic tubing.
4. For service entrance and generator feeders, use GRC conduit with watertight seals at any penetration through exterior walls.

C. Electrical Metallic Tubing (EMT) shall not be used in the following locations or under the following conditions:
1. Outside structure or on roof.
2. At or below grade.
3. In or beneath slabs on grade.
4. In hazardous locations.
5. Where exposed to physical damage, e.g. mechanical rooms.
6. Where subject to excessive moisture or deterioration.

7. For service entrance and generator feeders.

D. Minimum Raceway Size: 3/4-inch trade size.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

G. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

H. Install surface raceways only where indicated on Drawings.

I. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch radius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

X. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

AA. Locate boxes so that cover or plate will not span different building finishes.

BB. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

DD. Set metal floor boxes level and flush with finished floor surface.

EE. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 31 20 00 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 31 20 00 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 20 00 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Metraflex Company (The).
d. Pipeline Seal and Insulator, Inc.
e. Proco Products, Inc.

2. Sealing Elements: EPDM or Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Stainless steel.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Presealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Sealants and Sealant Primers shall comply with South Coast Air Quality Management District (SCAQMD) Rule #1168, amendment date January 7, 2005.
3. Sealant 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. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an orange field.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. White letters on a red field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.2 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

C. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F. Comply with UL 224.

2.3 CONDUCTOR IDENTIFICATION MATERIALS

A. Refer to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

2.4 FLOOR MARKING TAPE

A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.5 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: :

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
2. Thickness: 4 mils.
3. Weight: 18.5 lb/1000 sq. ft..
4. 3-Inch Tensile According to ASTM D 882: 30 lbf, and 2500 psi.
5. 3-InchTensile According to ASTM D 882: 300 lbf, and 12,500 psi.

2.6 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

2.7 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16-inch-thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with white letters on red face.
2. Punched or drilled for mechanical fasteners.

2.8 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a black background. Minimum letter height shall be ¾ inch.

2.9 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one-piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 25-foot maximum intervals in straight runs, and at 15-foot maximum intervals in congested areas.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- wide black stripes on 10-inch centers over orange background that extends full length of raceway or duct and is 12 inches wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high black letters on 20-inch centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 10-foot maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.

E. Power-Circuit Conductor Identification, 600 V or Less: Refer to Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables

F. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

I. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation.

J. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

K. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

L. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

M. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

N. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

O. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

P. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for transfer switches, generators, etc.

Q. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled (as applicable):

   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
   b. Disconnects.
   c. Enclosures and electrical cabinets.
   d. Access doors and panels for concealed electrical items.
   e. Switchboards.
   f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   g. Emergency system boxes and enclosures.
   h. Motor-control centers.
   i. Enclosed switches.
   j. Enclosed circuit breakers.
   k. Enclosed controllers.
   l. Variable-speed controllers.
   m. Push-button stations.
   n. Power transfer equipment.
   o. Contactors.
   p. Remote-controlled switches, dimmer modules, and control devices.
   q. Power-generating units.
   r. Monitoring and control equipment.
   s. Transfer Switches
   t. Generators

END OF SECTION

SECTION 26 05 73

ELECTRICAL POWER STUDIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes computer-based arc flash, short circuit and overcurrent protective device coordination studies.
   1. Study results shall be used to determine:
      a. Arc flash hazard limited and restricted boundaries.
      b. Incident energy.
      c. Interrupting requirements of overcurrent protective devices and withstand rating of all equipment within the electrical system.
      d. Coordination and settings of overcurrent protective devices.
      e. Creation of arc flash hazard labels.

1.2 DEFINITIONS

A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

C. SCCR: Short-circuit current rating.

D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

E. Engineering Study Specialist: Professional engineer in charge of performing the study and may also be the Engineer of Record.

1.3 SUBMITTALS

A. Product Data: Computer software program to be used for studies.

B. Prior to proceeding with the study, professional engineer shall submit the following for approval to proceed:
   1. List of similar project experience.
   2. Sample of a similar size study.

1.4 QUALITY ASSURANCE

A. Engineering Study Specialist's Qualifications: Professional engineer (P.E.) with a minimum 5 years' experience in the performance of power system studies. Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

B. Comply with the latest versions of National Fire and Protection Association (NFPA):
   1. NFPA 70 – National Electrical Code (Latest Edition)
   2. NFPA 70E – Standard for Electrical Safety in the Workplace

C. Comply with the latest standards of the Institute of Electrical and Electronics Engineers (IEEE):
   1. IEEE 242 for short circuit currents and coordination time intervals
   2. IEEE 399 for general study procedures
   3. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
   4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
   5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
   6. IEEE 1584 – Guide for Performing Arc Flash Hazard Calculations
   7. ANSI Z535 - Guide for Electrical Arc Flash labeling,
   8. IEEE 1584-2002 and IEEE 1584.1-2013-Guide for Specification and Scope and deliverable requirements for an Arc Flash Calculation study.

D. Comply with the latest standards of American National Standard Institute (ANSI):
   1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
   2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
   3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
   4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE

A. Software Developers: Provide software by the following:
   1. EasyPower, Inc.

B. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall be capable of allowing the professional engineer to demonstrate selective coordination with computer-generated, time-current coordination plots.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. For new projects, devices to be coordinated are indicated on Drawings.
   1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 STUDY PARAMETERS

A. Regardless of kVA size, equipment to be included in the study shall include but is not limited to the following:
   1. Panel boards
   2. Switchboards
   3. Disconnect Switches
   4. Motor Control Center
   5. Transformers
   6. Automatic Transfer Switches
   7. Variable Frequency Drives
   8. Control Panels
   9. UPS Equipment, in Normal and Bypass
   10. Portable generator connection box
   11. Generators, in the building and module.

B. Equipment rated 208-Vac and less when supplied by a single transformer rated less than 125 kVA must be included the study (Ref. NFPA 70E, 2018 Edition).

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for the conduct of the overcurrent protective device study.
   1. Verify completeness of data supplied in the one-line diagram, verified from field data or submittals.
   2. For new equipment, use characteristics from manufacturers' submittals.
   3. For existing equipment, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified and certified or licensed electricians, technicians or engineers. The qualifications of technicians and engineers shall comply with the requirements outlined in NFPA 70E, latest edition.

B. Gather and tabulate the following input data to support the electrical power studies. The list below is a guide. Comply with recommendations in IEEE 241 and IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the Professional Engineer (P.E.) in charge of performing the study.
   1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that

are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Electrical power utility impedance at the service. Utility supplied data must be used in all calculations.
3. Power sources and ties.
4. Short-circuit rating of each piece of equipment.
5. Voltage level at each bus.
6. For transformers, include kVA, primary and secondary voltages, connection type, impedance, and X/R ratio.
7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
10. Uninterruptible Power Supply systems (UPS), include UPS system input, bypass, and output circuit breakers.
11. Motor horsepower and NEMA MG 1 code letter designation.
12. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic). Cables to be field measured to within +/-5% to insure accuracy of all calculations.
13. Medium-voltage cable sizes, lengths, conductor material, and cable construction and metallic shield performance parameters.

3.4 REPORT REQUIREMENTS

A. Executive summary.

B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:
   1. Utility input.
   2. Protective device designations and ampere ratings.
   3. Cable size and lengths.
   4. Busway size, lengths and withstand ratings.
   5. Transformer kilovolt ampere (kVA) and voltage ratings.
   6. Motor and generator designations with kVA ratings.
   7. Switchgear, switchboard, motor-control center, and panelboard designations.
   8. Interconnection between all equipment.

D. Study Input Data: As described in article "Power System Data" in Part 3.

E. Table showing the incident energy for each device operating on utility, on generator, tap box and portable generator, and main-tie-main, UPS, and UPS Bypass. (see example attached).

3.5 SHORT-CIRCUIT STUDY

A. Calculations shall include the utility company source impedance, including transformer impedances, upstream available fault current, X/R ratio, etc. and ac fault-current decay from induction motors, synchronous motors, and asynchronous generators, and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
   1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

B. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault:
   1. Electric utility's supply termination point.
   2. Low-voltage switchgear.
   3. Generators and generator tap boxes.
   4. Automatic Transfer Switches.
   5. Motor-control centers.
   6. Standby generators and automatic transfer switches.
   7. Branch circuit panelboards, including a representative branch circuit breaker.
   8. Disconnect switches.
   9. Variable Frequency Drives
   10. Large HVAC equipment, above 50 HP.

C. Protective Device Evaluation:
   1. Evaluate equipment and protective devices and compare to short-circuit ratings.
   2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.

D. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   1. Voltage.
   2. Calculated fault-current magnitude.
   3. Fault-point X/R ratio.
   4. Equivalent impedance.

E. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
   1. Voltage.
   2. Calculated symmetrical fault-current magnitude.
   3. Fault-point X/R ratio.
   4. Calculated asymmetrical fault currents:
      a. Based on fault-point X/R ratio.
      b. Based on calculated symmetrical value multiplied by 1.6.
   5. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      a. Voltage.
      b. Calculated symmetrical fault-current magnitude.
      c. Fault-point X/R ratio.

F. Underrated Equipment Report: Provide a single comprehensive report indicating each underrated piece of equipment, its rating, and the available half cycle fault current.

G. Overall Underrated Equipment Report: Provide a single comprehensive report indicating each piece of underrated equipment, its actual rating, and the available half cycle fault current in Excel spreadsheet format.

H. Major remediation of underperforming equipment, such as “underrated” feeders, panelboards, switchboards, etc. or changing individual “underrated” breakers shall not be work of this section and shall be performed as a future project initiated by the owner.

3.6 PROTECTIVE DEVICE COORDINATION STUDY:

A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.

B. Comply with IEEE 399 for general study procedures.

C. The study shall be based on the device characteristics supplied by device manufacturer.

D. Begin analysis at the utility company’s OCPD ahead of the service, extending down to and including the system’s highest “non-adjustable” overcurrent protective devices. Analysis shall include both three phase and ground fault coordination.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. Transformer Primary Overcurrent Protective Devices:
   1. Device shall not operate in response to the following:
      a. Inrush current when first energized.
      b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
   2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

G. Motor Protection:
   1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
   2. Select protection for motors served at voltages more than 600 V according to IEEE 620.

H. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

I. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.

J. Coordination study results:

1. Adjustment of breakers is work of this section. All labels shall reflect the new settings of breakers and fuses, including the replaced mismatched fuses.
2. Provide a "Settings" chart, indicating the existing settings and below, the recommended setting of the overcurrent protective device. Include the following information in the "Settings" chart:
    a. Circuit Breakers:
        1) Device tag.
        2) Adjustable pickups and time delays (long time, short time, ground).
        3) Adjustable time-current characteristic.
        4) Adjustable instantaneous pickup.
        5) Recommendations on improved trip systems, if applicable.
    b. Fuses:
        1) Device tag.
        2) Current rating.
        3) Voltage.
        4) Fuse class and type.

K. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the each switching scheme and for emergency generation. Show the following information:
1. Device tag and title, one-line diagram inset with legend identifying the portion of the system covered.
2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
4. Plot the following listed characteristic curves, as applicable:
    a. Power utility's overcurrent protective device.
    b. Low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
    c. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    d. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    e. Cables and conductors damage curves.
    f. Ground-fault protective devices. If missing, provide all required settings as required by Code.
    g. Motor-starting characteristics and motor damage points.
    h. Generator short-circuit decrement curve and generator damage point.
    i. The largest feeder circuit breaker in each motor-control center, distribution panel, and panelboard.
5. Series rating on equipment allows the application of two series interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Both devices share in the interruption of the fault and selectivity is sacrificed at high fault levels. Maintain selectivity for tripping currents caused by overloads.
6. Provide adequate time margins between device characteristics such that selective operation is achieved.

7. Comments and recommendations for system improvements.

L. As it relates to coordination with upstream adjustable breakers and fuses, molded case thermal magnetic breakers shall be included in the study.

3.7 ARC FLASH HAZARD STUDY

A. Comply with NFPA 70E and its Annex D for hazard analysis study. Arc Flash labels shall be based on the scenario with the highest Incident Energy.

B. Employ the following methodology.
1. Use the short-circuit study output and the field-verified settings of the overcurrent devices.
2. Calculate maximum contributions of fault-current size.
3. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
4. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
5. Arc Flash boundary shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal./sq.cm.
6. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
   a. Fault contribution from induction motors should not be considered beyond three to five cycles.
   b. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
7. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
   a. When the circuit breaker is in a separate enclosure.
   b. When the line terminals of the circuit breaker are separate from the work location.
8. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum arcing time at two seconds based on IEEE 1584. Two second maximum arcing time should be limited to those devices with an actual clearing time greater than two seconds. Study shall be based on actual overcurrent protective device clearing times. For conditions where personnel egress is inhibited or the upstream devices total arcing time exceeds 2 seconds, engineering judgement should be used to evaluate both the arc flash hazard and the approach boundary.
9. Provide arc flash energy results for each location. (Category levels of arc flash are not to be applied).
10. Arc Flash calculations shall be made for all pertinent scenarios, including but not limited to On Utility, On Generator and On portable generator (at Tap Box), Main-Tie-Main, On UPS, On UPS Bypass.

3.8 REPORT SUBMITTAL

A. Submit the following information. Submittals shall be in digital form.
   1. Cover sheet, signed, dated, and sealed by a qualified professional engineer in the state in which the project is located.
   2. Power company information, with power company letter or email confirmation.
   3. Study input data, including completed computer program input data sheets in graphical form.
   4. Coordination-study including coordination curves graphically represented in log-log form and in color.
   5. Short Circuit Study.
   6. Equipment evaluation reports.
   7. Arc flash hazard report.
   8. Copy of all arc flash hazard labels.
   9. Minimum 24” X 36” and maximum 30” X 42” size of each single line diagram, numbered and dated.
   10. Underrated Equipment Report
   11. Overall Underrated equipment Report

B. Furnish one digital copy on a USB thumb-drive. Digital copy shall include an electronic file of the computer model.

3.9 AS-BUILT ELECTRICAL DRAWINGS

A. Provide the as-built single line diagram to be located and stored adjacent the main switchboard, close to the service entrance.

3.10 ARC FLASH LABELS

A. Arc flash labels shall be based on the recommended overcurrent protective devices settings and the replacement of mismatched fuses as described above. For underrated equipment requiring remediation and/or equipment rated above 40 cal./cm^2, appropriate arc flash labels as indicated below shall be applied.

B. Apply one arc-flash label on all applicable electrical equipment, for each circuit breaker or disconnect and per accessible vertical section in all multiple section pieces of equipment.

C. Labels shall meet UL 969 standard, compliance for durability and adhesion.

3.12 DEMONSTRATION

A. Engineering Study Specialist will present study and summarize the findings and recommendations (as requested), with the following main agenda items:
   1. Review that all equipment is labeled per the study's requirements.
   2. Identify equipment having a rating less than the available fault current.
   3. Identify equipment which requires mitigation to bring it up to date and in compliance with these guidelines.
   4. Identify other special situations addressed in the summary of the report.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

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. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching controls.
4. Indoor occupancy sensors.
5. Outdoor motion sensors.
6. Lighting contactors.
7. Emergency shunt relays.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC; TORK Products.
6. Tyco Electronics; ALR Brand.
7. Joe Blow

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: DPDT.
3. Contact Rating: 30-A inductive or resistive, 240-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule.
5. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
6. Programs: Each channel is individually programmable with eight on-off set points on a 24-hour schedule.
7. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program[on selected channels].
8. Astronomic Time: All channels.
9. Automatic daylight savings time changeover.
10. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. NSi Industries LLC; TORK Products.
4. Tyco Electronics; ALR Brand.

B. Description: Solid state, with DPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.
2. Eaton Corporation.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. NSi Industries LLC; TORK Products.
7. Sensor Switch, Inc.
8. Tyco Electronics; ALR Brand.
9. Watt Stopper.

B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
11. Control Load Status: User selectable to confirm that load wiring is correct.
12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.4 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.
2. Hubbell Building Automation, Inc.
3. Leviton Mfg. Company Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Watt Stopper.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).
b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.
b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

2.5 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Brands Lighting, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D.

12. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
5. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.

E. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lightolier Controls.
6. Lithonia Lighting; Acuity Brands Lighting, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC; TORK Products.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D.
12. Watt Stopper.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage; dual-technology type.

5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

D. Wall-Switch Sensor Tag WS2:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
2. Sensing Technology: PIR.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage; dual-technology type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

2.7 HIGH-BAY OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Hubbell Building Automation, Inc.

B. General Description: Solid-state unit. The unit is designed to operate with the lamp and ballasts indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
3. Continuous Lamp Monitoring: When lamps are dimmed continuously for 24 hours, automatically turn lamps on to full power for 15 minutes for every 24 hours of continuous dimming.
4. Operating Ambient Conditions: 32 to 149 deg F.
5. Mounting: Threaded pipe.
6. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
7. Detector Technology: PIR.
8. Power and dimming control from the lighting fixture ballast that has been modified to include the dimming capacitor and MyzerPORT option.

C. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.

D. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.

2.8 EXTREME-TEMPERATURE OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.
2. Sensor Switch, Inc.

B. Description: Ceiling-mounted, solid-state, extreme-temperature occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application in damp locations.
2. Operation: Turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
3. Operating Ambient Conditions: From minus 40 to plus 125 deg F.
4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
5. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
6. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind cover.

7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 10 fc; keep lighting off when selected lighting level is present.

C. Detector Technology: PIR. Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1500 sq. ft. when mounted on a 96-inch- high ceiling.
3. Detection Coverage (High Bay): Detect occupancy within 25 feet when mounted on a 25-foot- high ceiling.

2.9 OUTDOOR MOTION SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Bryant Electric.
2. Cooper Industries, Inc.
3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. NSi Industries LLC; TORK Products.
7. RAB Lighting.
8. Sensor Switch, Inc.
9. Watt Stopper.

B. General Requirements for Sensors: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Dual-technology (PIR and infrared) type, weatherproof. Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.. Comply with UL 773A.
3. Switch Rating:

    a. Lighting-Fixture-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent
    b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

4. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off." With bypass switch to override the "on" function in case of sensor failure.
5. Voltage: Match the circuit voltage type.
6. Detector Coverage:

    a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
    b. Long Range: 180-degree field of view and 110-foot detection range.

7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
9. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.10 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP.

3. Eaton Corporation.
4. General Electric Company; GE Consumer Industrial - Electrical Distribution; Total Lighting Control.
5. Square D.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

1. Monitoring: On-off status.
2. Control: On-off operation.

2.11 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 22 00

LOW-VOLTAGE TRANSFORMERS

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. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1. Distribution transformers.

1.3 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Source quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

B. 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.

C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.7 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Sector; Eaton Corporation; Cutler-Hammer Products.
2. General Electric Company.
3. Magnetek Power Electronics Group.
4. Square D Co./Groupe Schneider NA; Schneider Electric.
5. Powersmiths

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: One leg per phase.

C. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

D. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray ANSI 49 gray or ANSI 61 gray.

E. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

F. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

G. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

H. Sound-Level Requirements: NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 26 05 53 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions and requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.5 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 13

SWITCHBOARDS

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. Service and distribution switchboards rated 600 V and less.
2. Disconnecting and overcurrent protective devices.
3. Instrumentation.
4. Accessory components and features.
5. Identification.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Handle and prepare switchboards for installation according to NECA 400 and NEMA PB 2.1.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F.
b. Altitude: Not exceeding 6600 feet.

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.9 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. ABB/General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Indoor Enclosures: Steel, NEMA 250, Type 1.

D. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

E. Barriers: Between adjacent switchboard sections.

F. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

G. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

H. Buses and Connections: Three phase, four wire unless otherwise indicated.
1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated, or tin-plated, high-strength, electrical-grade aluminum alloy.
2. Ground Bus: 1/4-by-2-inch, hard-drawn copper of 98 percent conductivity, equipped with mechanical compression connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
3. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
4. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
5. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

I. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.

1. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

a. Instantaneous trip.
b. Long- and short-time pickup levels.
c. Long- and short-time time adjustments.
d. For main breaker 1,000 amps and larger: Ground-fault pickup level, time delay, and I^2t response.

2. Provide the following options on each breaker or as indicated on drawings:
a. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
b. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
c. Auxiliary Contacts: with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

B. Insulated-Case Circuit Breaker (ICCB): For main circuit breaker only, 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time time adjustments.
    c. For main breaker 1,000 amps and larger: Ground-fault pickup level, time delay, and I^2t response.

2.3 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:
1. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

    a. Phase Currents, Each Phase: Plus or minus 1 percent.
    b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
    c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
    d. Megawatts: Plus or minus 2 percent.
    e. Megavars: Plus or minus 2 percent.
    f. Power Factor: Plus or minus 2 percent.
    g. Frequency: Plus or minus 0.5 percent.
    h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
    i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.4 IDENTIFICATION

A. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.

B. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

C. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400 or NEMA PB 2.1.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NECA 400 or NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 03 30 00 "Cast-in-Place Concrete." or Section 03 30 53 "Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures.

Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install filler plates in unused spaces of panel-mounted sections.

F. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

G. Install spare-fuse cabinet.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

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. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.
3. Load centers.
4. Electronic-grade panelboards.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Include evidence of NRTL listing for series rating of installed devices.
6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
7. Include wiring diagrams for power, signal, and control wiring.
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

C. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards.

B. Handle and prepare panelboards for installation according to NECA 407 and NEMA PB 1.

1.8 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: From 23 deg F to plus 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.9 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. ABB/General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Square D; a brand of Schneider Electric.

B. Enclosures: Surface-mounted cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.
c. Kitchen and Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
4. Finishes:

a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
b. Back Boxes: Galvanized steel.

5. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.

C. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 DISTRIBUTION PANELBOARDS

A. Panelboards: NEMA PB 1, power and feeder distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

C. Mains: Circuit breaker or Main Lugs only as indicated on plans.

D. Branch Overcurrent Protective Devices for Circuit-Breaker: Bolt-on circuit breakers or plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: Circuit breaker or main lugs only.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.5 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. For frame sizes above 250 A, provide electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:

    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I squared x t response.
4. GFCI Circuit Breakers: Single- and two-pole configurations with ground-fault protection.
5. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:

    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    e. Shunt Trip: Integrally mounted.
    f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 40 or 7 NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 or NEMA PB 1.1.

B. Mount top of trim 90 inches above finished floor unless otherwise indicated.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

E. Install filler plates in unused spaces.

F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

END OF SECTION

SECTION 26 25 50

DUAL PURPOSE GENERATOR/LOAD BANK DOCKING STATION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

1.2 GUARANTEE/WARRANTY

A. The equipment installed under this contract shall be left in proper working order. Replace, without additional charge, new work or material which develops defects from ordinary use within one year.

B. New materials and equipment shall be guaranteed against defects in composition, design or workmanship. Guarantee certificates shall be furnished.

PART 2 - PRODUCTS

2.1 Dual Purpose Docking Station

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. TRYSTAR

2. OR TXDOT APPROVED EQUAL

2.2 GENERAL REQUIREMENTS

A. Unit shall be a dual purpose generator/load bank docking station capable of complying with the latest NEC 700.3 requirements. Dual purpose docking station shall include two sets of Camloks. One set, readily accessible, for connection of a temporary load bank. The second set, shall be behind a Kirk Key Interlocked door. Permanent generator Circuit Breaker shall be Kirk Keyed in common with the access panel covering the portable generator Camloks so that the portable generator cannot be connected to the Load bus while the permanent generator is connected to the Load bus.

B. Entire package must be listed to ETL or UL 1008 Standards. UL listing of individual components is not acceptable.

C. Enclosures:

1. Pad mount, NEMA 3R rain-tight, aluminum enclosure.

a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of cables from portable generator or portable load bank. NEMA 3R integrity shall be maintained with access plate open for cable entry.
b. Front, side, and bottom through a front access panel shall be accessible for maintenance.
c. Top, side, and bottom through a front access panel shall be accessible for permanent cabling.

2. Finishes:
   a. Paint after fabrication. Powder coated Hammer Gray.
3. Unit shall contain Micro-Switch on KK Access door for annunciation on supplied remote annunciator panel

D. Phase, Neutral, and Ground Buses:

1. Material: Silver-plated, Tin-plated or Hard-drawn copper, specified upon order.
2. Equipment Ground Bus: bonded to box.
3. Isolated Ground Bus: insulated from box.
4. Ground Bus: 25%, 50% or 100% of phase size.
5. Neutral Bus: Neutral bus rated 100 percent of phase bus.
6. Round edges on bus.
7. Entire construction shall be Bussing. Cabling between Camloks or sections shall not be acceptable.

E. Load bank and portable generator connectors shall be Camlok style mounted on gland plate (male for the portable generator and female for the portable load bank. Male Camloks to be behind Kirk Key Interlocked Door.

1. An additional Set of Mechanical Lugs, accessible from the front of the docking station, shall also be required for temporary generator connection.

2. Camloks are required to have phase color identification paint at their mounting point to the docking station. Camlok shall be color coded according to system voltage:
   a. A phase – Black or Brown
   b. B phase – Red or Orange
   c. C phase – Blue or Yellow
   d. N Neutral – White
   e. G Ground - Green

F. Permanent generator connectors shall be broad range set-screw type, located behind an aluminum barrier.

G. Voltage & Phase shall be as shown on project one line drawing. Camloks shall be color coded as appropriate for the specified voltage.

H. Amperage rating shall be as shown on project one line drawing.

I. A Load Dump Circuit will be provided, so that if the Utility power were to fail during a temporary load bank test, the load bank would shed itself and allow the generator to pick up the building load.

J. A Remote Start Terminal will be provided, so that a temporary generator can be remotely start and stopped in an identical manner as the permanent generator set.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive Generator Docking Station for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Surface, Flush or Base Mounted: Specified with order.
   1. Install anchor bolts to elevations required for proper attachment to Generator Docking Station.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 FIELD QUALITY CONTROL

A. Third Party Tests and Inspections to include the following:

   1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   3. Perform the following infrared scan tests and inspections and prepare reports:

      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each Generator Docking Station. Remove front panels so joints and connections are accessible to portable scanner.

B. Generator Docking Station will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports, including a certified report that identifies Generator Docking Station and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 25 50

SECTION 26 27 26

WIRING DEVICES

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. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge-suppression units.
4. Weather-resistant receptacles.
5. Snap switches and wall-box dimmers.
6. Solid-state fan speed controls.
7. Wall-switch and exterior occupancy sensors.
8. Communications outlets.
9. Pendant cord-connector devices.
10. Cord and plug sets.
11. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

2.5 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Description:

a. Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
b. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.6 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.7 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.8 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

C. Pilot-Light Switches, 20 A:

1. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

F. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2.9 DECORATOR-STYLE DEVICES

A. Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, and UL 498.

B. GFCI, Non-Feed-Through Type, Convenience Receptacles: Square face, 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and UL 943 Class A.

C. Toggle Switches, Square Face, 120/277 V, 20 A: Comply with NEMA WD 1, UL 20, and FS W-S-896.

D. Lighted Toggle Switches, Square Face, 120 V, 20 A: Comply with NEMA WD 1 and UL 20.

1. Description: With neon-lighted handle, illuminated when switch is "off."

2.10 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. Minimum 1200 W dimmers, derate per manufacturer’s requirements when ganged with other devices. Illuminated when "off."

2.11 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.12 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type or flap-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular or Round, die-cast aluminum or solid brass with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Coordinate exact requirements with IT consultant.

2.13 POKE-THROUGH ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. product by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Pass & Seymour/Legrand.
3. Square D/Schneider Electric.
4. Thomas & Betts Corporation.
5. Wiremold/Legrand.

C. Description:

1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
2. Comply with UL 514 scrub water exclusion requirements.
3. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks complying with requirements in Section 27 20 00 "Communications Horizontal Cabling."
4. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
6. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.

7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, four-pair cables that comply with requirements in Section 27 20 00 "Communications Horizontal Cabling."

2.14 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold/Legrand.

B. Description:

1. Two-piece surface metal raceway, with factory-wired multioutlet harness.
2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Multioutlet Harness:

1. Receptacles: 20-A, 125-V, NEMA WD 6 Configuration 5-20R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: as indiacted on plans.
3. Wiring: No. 12 AWG solid, Type THHN copper, single circuit or two circuit, connecting alternating receptacles as indicated on plans.

2.15 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Color as selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

    a. Cut back and pig-tail, or replace all damaged conductors.
    b. Straighten conductors that remain and remove corrosion and foreign matter.
    c. Pig-tailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 20- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Decorator Devices: Install in all finished spaces.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

I. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

J. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 26 05 53 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 20-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

C. Wiring device will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 28 13

FUSES

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. Cartridge fuses rated 600 V ac and less for use in the following:

   a. Control circuits.
   b. Enclosed controllers.
   c. Enclosed switches.

2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
4. Coordination charts and tables and related data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bussman

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
   1. Type J: 600-V, zero- to 600-A rating, 200 kAIC**,** time delay.
   2. Type T: 250-V, zero- to 1200-A, 600-V, zero- to 800-A rating, 200 kAIC**,** time delay.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
   1. Disconnects feeding motor starters: Class J, or Class T.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Molded-case circuit breakers (MCCBs).
3. Molded-case switches.
4. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. All disconnect fuses shall be fused. Unfused disconnects shall not be permitted.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. ABB/General Electric Company.
3. Square D; a brand of Schneider Electric.

C. Heavy Duty, Single Throw, 240 or 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper neutral conductors.
3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.2 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. ABB/General Electric Company.
3. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. If indicated on the plans, provide ground-fault pickup level, time delay, and I^2t response.

F. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. If indicated on plans, provide Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.3 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Areas: NEMA 250, Type 4X Insert type, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Install fuses in fusible devices.

C. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

END OF SECTION

SECTION 26 29 13

ENCLOSED CONTROLLERS

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 the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.

B. Related Section:

1. Section 26 29 23 "Variable-Frequency Motor Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on variable torque loads in ranges up to 200 hp.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Nameplate legends.
d. Short-circuit current rating of integrated unit.
e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.
f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 26 05 48.16 "Seismic Controls for Electrical Systems."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; [install temporary electric heating, with at least 250 W per controller] [connect factory-installed space heaters to temporary electrical service].

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 124 deg F.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle; marked to show whether unit is off or on.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Configuration: Non-reversing.
3. Flush mounting in finished areas, Surface mounting in mechanical and electrical rooms and unfinished spaces.
4. Red and Green pilot lights.
5. Capable of being locked in the Open positions

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button ; melting alloy type.
4. Surface mounting.
5. Red amd Green pilot light.

D. Magnetic Controllers: Full voltage, across the line, electrically held for all motors ½ HP and above.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Configuration: Nonreversing.
3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

a. CPT Spare Capacity: 100 VA.

6. Solid-State Overload Relay:

a. Switch or dial selectable for motor running overload protection.
b. Sensors in each phase.
c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.

7. N.C. and N.O., isolated overload alarm contacts.
8. External overload reset push button.

E. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
b. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
c. Rockwell Automation, Inc.; Allen-Bradley brand.
d. Siemens Energy & Automation, Inc.
e. Square D; a brand of Schneider Electric.

2. Fusible Disconnecting Means:

a. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate Class J fuses.
b. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 4X.
3. Kitchen and Wash-Down Areas: Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: Type 4.

2.3 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, oiltight type.

a. Push Buttons: Covered types; momentary as indicated.
b. Pilot Lights: LED types; colors as indicated.
c. Selector Switches: Rotary type.

2. Elapsed Time Meters: Heavy duty with digital readout in hours ; resettable.
3. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. N.C. and N.O. Reversible N.C./N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 26 05 29 "Hangers and Supports for Electrical Systems."

B. Install fuses in each fusible-switch enclosed controller.

C. Install fuses in control circuits if not factory installed. Comply with requirements in Section 26 28 13 "Fuses."

D. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

F. Install power factor correction capacitors. Connect to the [line] [load] side of overload relays. If connected to the load side of overload relays, adjust overload heater sizes to accommodate the reduced motor full-load currents.

G. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices and facility's central control system. Comply with requirements in Section 26 05 23 "Control-Voltage Electrical Power Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect and Construction Manager before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed controllers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Architect and Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers at 50 percent.

E. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

F. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 "Overcurrent Protective Device Coordination Study."

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

END OF SECTION

SECTION 26 32 13

DIESEL ENGINE GENERATORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes engine generator set, heat exchanger, exhaust silencer and fittings, fuel fittings, remote control panel, battery, and charger.

B. Related Sections:
1. Section 260526 - Grounding and Bonding for Electrical Systems.
2. Section 260553 - Identification for Electrical Systems.
3. Section 262826 - Enclosed Transfer Switches.

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA ICS 10 - Industrial Control and Systems: AC Transfer Switch Equipment.
3. NEMA MG 1 - Motors and Generators.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 30 - Flammable and Combustible Liquids Code.
2. NFPA 99 - Standard for Health Care Facilities.
3. NFPA 110 - Standard for Emergency and Standby Power Systems.

D. Underwriters Laboratories Inc.:

1. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.3 SYSTEM DESCRIPTION

A. Description: Engine generator assembly and accessories to provide source of power for applications in accordance with NFPA 110.

B. Capacity: kW Rating per drawings at elevation of 3300 feet above sea level, standby rating using specified engine cooling scheme.

1.4 SUBMITTALS

A. Section 013300 - Submittal Procedures: Submittal procedures.

B. Shop Drawings: Indicate electrical characteristics and connection requirements. Include plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, electrical diagrams including schematic and interconnection diagrams.

C. Product Data: Submit data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, and remote radiator.

D. Test Reports: Indicate results of performance testing.

E. Manufacturer's Field Reports: Indicate inspections, findings, and recommendations.

1.5 CLOSEOUT SUBMITTALS

A. Section 017000 - Execution and Closeout Requirements: Closeout procedures.

B. Operation and Maintenance Data: Submit instructions and service manuals for normal operation, routine maintenance, oil sampling and analysis for engine wear, and emergency maintenance procedures.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented.

B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.

1.7 WARRANTY

A. Section 017000 - Execution and Closeout Requirements: Product warranties and product bonds.

B. The manufacturer's standard warranty shall be five (5) years after final acceptance of the system and shall include repair parts, labor, travel expense necessary for repairs at the job site, and expendables (lubricating oil, filters, antifreeze, and other service items made unusable by the defect) used during repair. All preventative maintenance work required by the manufacturer to satisfy the warranty requirements shall be included in the contract and be performed by manufacturer’s direct field service organization up to one year after final acceptance.

1.8 MAINTENANCE SERVICE

A. Section 017000 - Execution and Closeout Requirements: Maintenance service.

B. All preventative maintenance work required by the manufacturer to satisfy the warranty requirements shall be included in the contract and be performed by manufacturer's direct field service organization up to one year after final acceptance.

1.9 MAINTENANCE MATERIALS

A. Section 017000 - Execution and Closeout Requirements: Spare parts and maintenance products.

B. Furnish one set of tools required for preventative maintenance of engine generator system. Package tools in adequately sized metal tool box.

C. Furnish two of each fuel, oil and air filter element.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS

A. Temperature: 105 degrees F.

B. Altitude: 3,300 feet.

2.2 ENGINE

A. Manufacturers:

1. Cummins.
2. Caterpillar.
3. TxDOT Approved Equal.

B. Product Description: Water-cooled in-line or V-type, four-stroke cycle, internal combustion engine.

C. Rating: Sufficient to operate under 10 percent overload for one hour in ambient of 105 degrees F at elevation of 3300 feet.

D. Fuel System: Diesel

E. Engine speed: 3600 rpm (Maximum).

F. Safety Devices: Engine shutdown on high water temperature, low oil pressure, overspeed, and engine over crank. Limits as selected by manufacturer.

G. Engine Starting: DC starting system with positive engagement, number and voltage of starter motors in accordance with manufacturer's instructions. Furnish remote starting control circuit, with MANUAL-OFF-REMOTE selector switch on engine-generator control panel.

H. Engine Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 volts AC.

I. Radiator: Radiator using glycol coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F. Radiator air flow restriction 0.5 inches of water maximum.

J. Engine Accessories: Fuel filter, lube oil filter, intake air filter, lube oil cooler, fuel transfer pump, fuel priming pump, gear-driven water pump. Furnish fuel pressure gage, water temperature gage, and lube oil pressure gage on engine/generator control panel.

K. Mounting: Furnish unit with suitable spring-type vibration isolators and mount on structural steel base.

2.3 GENERATOR

A. Manufacturers:

1. Cummins.
2. Caterpillar.
3. TxDOT Approved Equal.

B. Product Description: NEMA MG1, three phases, four poles, re-connectable brushless synchronous generator with brushless exciter.

C. Rating: kW per drawings, at 0.8 power factor, voltage and phase shall be per the drawings, 60 Hz.

D. Insulation Class: F.

E. Temperature Rise: 130 degrees C Standby.

F. Enclosure: NEMA MG1, open drip proof.

G. Voltage Regulation: Furnish generator mounted volts per hertz exciter-regulator to match engine and generator characteristics, with voltage regulation plus or minus 1 percent from no load to full load. Furnish manual controls to adjust voltage droop, voltage level (plus or minus 5 percent) and voltage gain.

2.4 GOVERNOR

A. Manufacturers:

1. Cummins.

2. Caterpillar.
3. TxDOT Approved Equal.

B. Product Description: Electronic governor to maintain engine speed within 0.5 percent, steady state, and 5 percent, no load to full load, with recovery to steady state within 2 seconds following sudden load changes. Equip governor with means for manual operation and adjustment.

2.5 HEAT EXCHANGER

A. Manufacturers:

1. Cummins.
2. Caterpillar.
3. TxDOT Approved Equal.

B. Product Description: Engine or base mounted heat exchanger and expansion tank of type and capacity recommended by engine manufacturer. Furnish solenoid shutoff valve for field installation on cooling water inlet, configured to open when engine runs.

2.6 AUTOMATIC TRANSFER SWITCH

A. Reference the following related Section:
1. 26 36 01 – Automatic Transfer Switch.

2.7 ACCESSORIES

A. Sub-Base, Skid-Mounted, Steel Fuel Tank: Factory installed, piped, and vented, complying with UL 142 fuel oil tank. Features include the following:
1. Tank level indicator.
2. Minimum capacity: Fuel for 48 hours of continuous operation at 100 percent rated load.
3. Vandal resistant fill cap.
4. Containment provisions: Comply with requirements of authorities having jurisdiction.

B. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless steel exhaust fitting, sized in accordance with engine manufacturer's instructions.

C. Batteries: Heavy duty, diesel starting type lead-acid storage batteries, 170 ampere-hours minimum capacity. Match battery voltage to starting system. Furnish cables and clamps.

D. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.

E. Battery Charger: Current limiting type designed to float at 2.17 volts for each cell and equalize at 2.33 volts for each cell. Furnish overload protection, full wave rectifier, DC voltmeter and ammeter, and 120 volts AC fused input. Furnish wall mounted enclosure to meet NEMA 250, Type 1 requirements.

F. Line Circuit Breaker: UL 489, molded case circuit breaker on generator output with integral thermal and instantaneous magnetic trip in each pole. Furnish battery voltage operated shunt trip, connected to open circuit breaker on engine failure. Unit mount in enclosure to meet NEMA 250, Type 1 requirements.

G. Engine-Generator Control Panel: NEMA 250, Type 1 generator-mounted control panel enclosure with engine and generator controls and indicators. Furnish provision for padlock and the following equipment and features:

1. Frequency Meter: 45-65 Hz. range, 3.5 inch dial.
2. AC Output Voltmeter: 3.5 inch dial, 2 percent accuracy, with phase selector switch.
3. AC Output Ammeter: 3.5 inch dial, 2 percent accuracy, with phase selector switch.
4. Output voltage adjustment.
5. Push-to-test indicator lamps, one each for low oil pressure, high water temperature, over speed, low fuel level, and over crank.
6. Engine start/stop selector switch.
7. Engine running time meter.
8. Oil pressure gage.
9. Water temperature gage.
10. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.
11. Additional visual indicators and alarms in accordance with by NFPA 110.
12. Remote Alarm Contacts: Factory wire SPDT contacts to terminal strip for remote alarm functions in accordance with NFPA 110.

H. Remote Annunciator Panel: Surface mounted panel with brushed stainless-steel finish. Furnish alarm horn, and indicators and alarms as follows:

1. High battery voltage (alarm).
2. Low battery voltage (alarm).
3. Low fuel (alarm).
4. System ready.
5. Anticipatory-high water temperature.
6. Anticipatory-low oil pressure.
7. Low coolant temperature.
8. Switch in off position (alarm).
9. Over crank (alarm).
10. Emergency stop (alarm).
11. High water temperature (alarm).
12. Overspeed (alarm).
13. Low oil pressure (alarm).
14. Line power available.
15. Generator power available.
16. Lamp test and horn silence switch.

I. Weather Protective Enclosure: Provide an overall weather-protective enclosure with removable side panels and a hinged padlockable meter panel door to make the engine generating plant suitable for outdoor installation under all weather conditions. Prime all exposed metal parts with a suitable rust inhibitor applied to the clean, bare metal followed by

two coats of an epoxy paint for exterior weather exposure. Cover all openings in the housing with 1/4-inch galvanized hardware cloth to keep out birds and small animals.

J. Communications: Modbus Protocol, RS485 Serial Communications port with RTU communications interface card. Ensure that the generator controller is furnished to communicate with the remote annunciator and at least one additional RS485 Modbus external power monitoring device at the same time using independent cables, connections, and ports

2.8 SOURCE QUALITY CONTROL

A. Provide shop inspection and testing of completed assembly.

PART 3 - EXECUTION

3.1 EXISTING WORK

A. Disconnect and remove abandoned engine-generator assemblies and accessories.

B. Clean and repair existing engine-generator assemblies to remain or to be reinstalled.

3.2 INSTALLATION

A. Install engraved plastic nameplates in accordance with Section 260553.

B. Install Generator Set on concrete pad detailed in the plans. Anchor base frame to pad in accordance with Manufacturer’s recommendations.

C. Ground and bond generator and other electrical system components in accordance with Section 260526.

3.3 FIELD QUALITY CONTROL

A. Section 017000 - 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 7.22.

D. Perform manufacturer’s recommended in field on site load bank testing. Load bank to be supplied by the contractor along with all testing equipment and data monitors.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 014000 - Quality Requirements: Manufacturer's field services.

B. Before the work is accepted, an authorized representative of the Manufacturer shall personally inspect the installation and operation of the equipment to determine that it is properly installed and in proper operating order. If the transfer switch(es) and generator sets are furnished by different manufacturers, authorized technical representatives of both transfer switch and generator set manufacturers shall be present during the field test to verify operational compliance. The qualifications of the representative shall be appropriate to the technical requirements of the installation and shall be submitted to the owner for approval. The decision of the owner concerning the appropriateness of the representative shall be final. Testing and checking shall be accomplished during the work where required by work being concealed, and at the completion of the work otherwise. In addition, the Contractor shall submit to the Design Engineer a signed statement from the representative certifying as follows: "I certify that the materials and/or equipment listed below have been personally inspected by the undersigned authorized Manufacturer's representative and is properly installed and operating in accordance with the Manufacturer's recommendations".

C. Employ and pay for services of a manufacturer's authorized representative to carry out and coordinate all the testing requirements as indicated in Section 3.4. The firm shall be acceptable to the owner and shall have at minimum 5 years of experience on the field for commissioning and testing of standby power generator systems.

D. Perform field tests at the site after installation is complete and in the presence of the Owners' representative.

E. Manufacturer's authorized representative. Have the engine generator manufacturer furnish a representative to operate the complete system during the field tests, to check all details of the installation, and to instruct the operators. If transfer switch and generator set is furnished by two different manufacturers, a representative shall be furnished by each manufacturer. Include, at no additional cost to the owner, the services of the representative.

F. Preparation for Testing. Have the engine generator system completed and ready for operation at the time field tests are to be run. Provide all necessary lube oil and coolant, and install new, unused oil and air filter elements. Provide fuel necessary to carry out all tests.

G. Instruments. Provide all instruments necessary to conduct the tests.

H. Startup Commissioning. Notify the owner two weeks before the start up commissioning/tests begin. Perform manufacturer's recommended startup commissioning check of the generator prior to field testing. The Contractor shall submit a copy of the test procedures and system checkout lists to Owner/Engineer for review prior to commencing field testing.

I. Complete a 4-hour, full-load test using contractor-supplied load bank as a condition for final acceptance. Read and record all gauges and meters before starting the test, then every 10 minutes during the first hour, and then every half hour during remainder of the 4-hour period. Remove load and run engine generator at no load for 15 minutes to allow engine to cool; then shut unit down and immediately make one last recording of all gauge and meter indications. Have recordings field witnessed during test by the Engineer. Deliver three copies of such witnessed recordings to the Engineer within one week of the test.

J. Minimum parameters to record during the full load test: output voltage, output ampacity, frequency, real power, reactive power, engine temperatures, fluid temperatures, air flow

temperatures, ensure cooling system is running. Any other parameters as recommended by manufacturer's authorized representative.

K. Actual Facility Load Tests.

1. After the successful 4-hour, full-load test described above, make additional on-site tests using actual available facility loads in the presence of the owner to demonstrate satisfactory performance of the complete engine generator system. Include different sequenced start-ups of the various specified loads, as directed by the Engineer.

2. As a final test, after all other tests have been successfully completed, the contractor is to perform a simulated power failure test. Generator system shall be made ready for automatic operation and started by means of the test transfer switch on the automatic transfer switch. Operate the engine generator system under actual available facility loads for 2 hours of successful operation. There shall be a 10 minute unloaded run at the conclusion of the test to allow engine to cool before shutdown.

L. TxDOT will supply fuel to tank up to 80% after all tests are satisfactorily completed.

3.5 ADJUSTING

A. Section 017000 - Execution and Closeout Requirements: Testing, adjusting, and balancing.

B. Adjust generator output voltage and engine speed to meet specified ratings.

3.6 CLEANING

A. Section 017000 - Execution and Closeout Requirements: Final cleaning.

B. Clean engine and generator surfaces. Replace oil and fuel filters with new.

3.7 TRAINING

A. Provide manufacturer recommended onsite training regarding operation and preventive maintenance of generator after satisfactory completion of all field tests as indicated in section 3.4.

END OF SECTION 26 32 13

SECTION 26 36 01

TRANSFER SWITCHES (BYPASS ISOLATION)

PART 1 - GENERAL

1.01 SCOPE

A. Furnish and install Automatic Transfer Switches (ATS) with number of poles, amperage and voltage as per facility electrical distribution. Withstand and Close-on ratings as listed in this specification are provided as a minimum requirement.

1.02 CODES and STANDARDS

The Automatic Transfer Switches and controls shall conform to the requirements of the following:

A. UL 1008: Underwriters Laboratories Standard for Transfer Switch Equipment
B. NFPA 70 National Electrical Code
C. NFPA 99 Essential Electrical Systems for Health Care Facilities
D. NFPA 110 Standard for emergency and standby power systems
E. ANSI/IEEE 446 Recommended Practice for Emergency and Standby Power Systems for Commercial Applications
F. NEMA ICS 10 P1 Industrial Control and Systems Part 1: Electromechanical AC Transfer Switch Equipment
G. IBC-2006 International Building Code-Seismic Certified
H. UL 508 Standard for Industrial Control

1.03 SUBMITTALS

A. Manufacturer shall submit shop drawings for review, which shall include the following, as a minimum:

1. Descriptive Literature
2. Plan, elevation, side and front view arrangement drawings, including overall dimension, weights and clearances, as well as mounting or anchoring requirements and conduit entrance locations.
3. Schematic diagrams
4. Wiring Diagrams
5. Accessory list
6. Warranty Documentation:
    a ATS Shall be provided with manufactures standard parts, labor and travel warranty for the duration of 5 years from date of shipment.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Russ Electric type RTS03ABLB
or
B. TxDOT approved equivalent

2.02 CONSTRUCTION

A. General

1. The Automatic Transfer Switch and associated Bypass/Isolation Switch shall be furnished as shown on the drawings. Voltage and continuous current ratings shall be as shown.

1. On 3 phase, 4 wire systems, utilizing ground fault protection, a true 4-pole switch shall be supplied with all four poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the fourth pole shall be identical to the rating of the main poles.

2. The transfer switch shall be mounted in a NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12-gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008.

3. Both units shall be bussed together with silver plated copper bus to provide a complete pre-tested assembly. Construction shall be such that the contractor needs to install only power and control connections.

4. Bypass/isolation switches shall provide a safe and convenient means for manually bypassing and isolating the automatic transfer switch, regardless of the condition or position of the ATS, with the ability to be used as an emergency back-up system in the event the transfer switch should fail. In addition, the bypass/isolation switch shall be utilized to facilitate maintenance and repair of the automatic transfer switch.

5. The automatic transfer switch shall be completely isolated from the bypass/isolation switch by means of insulating barriers and separate access doors.

6. When the automatic transfer switch is bypassed and in the isolated position, the automatic transfer switch cubicle shall be electrically isolated via rear shutter system preventing accidental contact or exposure to energized cables, bussing and electrical parts. Automatic transfer switch shutters allow the safe removal of the automatic transfer switch for maintenance or repair without exposing technician to energized circuits or parts.

7. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.

8. The combination automatic transfer and bypass/isolation switch shall be top and bottom accessible.

9. The main contacts shall be capable of being replaced without removing the main power cables.

10. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.

11. All bolted bus connections shall have Belleville compression type washers.

12. When a solid neutral is required, a fully rated bus bar with required AL/CU neutral lugs shall be provided.

13. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge 600-volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers.

14. The complete combination automatic transfer bypass/isolation switch assembly shall be equipped with 90 degrees C rated copper/aluminum solderless mechanical type lugs.

15. The complete combination automatic transfer bypass/isolation switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.

B. Bypass/Isolation Construction

1. All main contacts and operating linkages of the bypass/isolation section shall be the same as the ATS, except that the operation shall be manual.

2. The bypass/isolation switch shall have the same electrical ratings as the associated ATS. The bypass/isolation shall be the load break type. The main contacts of the bypass switch shall be mechanically locked in both the normal bypass and the emergency bypass positions without the use of hooks, latches, magnets or springs and shall be silver-tungsten alloy, protected by arcing contacts. The switching mechanism shall provide “Quick-Break,” “Quick- Make” operation of the contacts.

3. The primary bus work of the draw-out automatic transfer switch shall be connected to the stationary bus stabs in the freestanding cubicle by silver plated segmented, self-aligning, primary disconnect fingers to facilitate proper alignment between the removable draw-out when the ATS is withdrawn and shall be available for inspection without disturbing or de-energizing the main bus.

4. The secondary control disconnect contacts mounted on the ATS shall be self- aligning and shall plug into stationary elements mounted on the freestanding cubicle.

5. The isolating portion of the bypass/isolation shall allow the ATS to be disconnected from all sources of power and control without opening the enclosure door. The transfer switch shall have a true draw-out configuration that does not require disconnection of any electrical or mechanical device by maintaining personnel. The ATS shall be provided with rollers or casters to allow it to be removed from the enclosure simply by

rolling it out. The automatic transfer and bypass/isolation switch shall have three modes of operation. Automatic, the ATS connected and in automatic operating mode. Test, the ATS disconnected from the main bus but controls connected allowing testing of the ATS without impact on the load. Isolation, the ATS is completely disconnected for the bypass/isolation switch and free to be removed from the enclosure.

6. Positive mechanical interlocks shall be provided to ensure that the bypass/isolation functions can be accomplished without the danger of a short circuit. Overlapping contact bypass/isolation switches, that are dependent upon the position of the ATS for proper operation, are not acceptable.

7. A fourth pole, switched neutral shall be provided if the associated ATS is designed as a 4-pole. Basic 4-pole bypass/isolation switch construction shall be identical to the associated ATS construction.

8. Necessary controls shall be provided to ensure that the engine run circuit remains closed when the switch is in the bypassed to emergency position, even if the associated ATS is in the normal position or completely removed from the enclosure.

C. Automatic Transfer Switch

1. The transfer switch shall be double throw, actuated by two electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.
    a ATS shall utilize preloaded, over-center spring mechanisms so that contact speed and pressure are independent of the motivator for rapid arc quenching, safe manual operation under load and increased contact lifespan

2. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungsten alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable.

3. The transfer switch shall be equipped with a safe external manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact to contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The external manual operator shall be safely operated, under load, from outside of the transfer switch enclosure while the enclosure door is closed. Push buttons and/or selector switches are not acceptable for this function. External manual operator shall not be dependent on system control logic.

D. Transfer Switch Controller

1. The transfer switch shall be equipped with a Microprocessor Controller with a Power Supply Module, CPU and I/O Modules for all voltage and ampere ratings. The controller shall be capable of both Serial and Ethernet communications.

2. The controller shall contain voltage sensing modules capable of direct single phase or three phase sensing of each source from 120 VAC to 600 VAC. The Power Supply Module shall accept a 24 VDC external power source allowing controller communications in the event of a power outage.

3. Voltage sensing shall be true RMS type and accurate to +/- 1% of nominal voltage. Frequency sensing shall be accurate to +/- 0.05Hz. The operating temperature range shall be –20 to +50 degrees C and storage from –40 to +90 C.

4. The controller shall connect to the transfer switch through an interconnecting wiring harness. Interfacing relays shall be provided to isolate the controller from abnormal voltages applied to any and all customer input and output wiring terminals.

5. All customer interface connections shall be wired to a common DIN rail Cage Clamp terminal block. Sufficient space shall be provided to allow for future modifications and upgrades.

6. The controller shall meet or exceed the requirements for Electromagnetic Compatibility as follows:

   a EN55022 (CISPR11) Conducted and Radiated emissions, Class B

   b EN61000-4-2 (Level 4) ESD immunity test
   ENG6100-4-3 (ENV50140) Radiated RF
   EN61000-4-4 Electrical fast transient/burst immunity test
   EN61000-4-5 IEEE C62.41 Surge immunity test
   EN61000-4-6 (ENV50141) Conducted immunity test
   EN61000-4-11 Voltage dips and interruption immunity

   c IEEE 472 (ANSI C37.90A) Ring wave immunity

E. Controller Display and Keypad

1. A color, ¼ VGA minimum, graphical display shall be provided for viewing data and setting operational parameters. Parameters shall also be available for viewing remotely and limited control through a front accessible USB communications port.

2. The Controller shall provide high intensity LED’s for the following:

   a Source Availability - Indicates the source voltage and frequency are within preset parameters.
   b Source Connected - Indicates the source main contacts closed and the load being served from the source.
   c XFER Inhibit - Indicates that the ATS is being inhibited from Automatic operation to the unconnected source.
   d Alarm – Indicates an alarm condition is active.
   e TD Active – Indicates that a transfer switch time delay is actively timing.

3. For ease of navigation, the display shall include the following:

a Soft Keys – Change function based on user location in the menu structure.
b Dedicated Navigational Keys – Home, Scroll Up, End, Escape and Enter.
c Dedicated Pushbuttons for Alarm Reset, Test, Control and Information.

PART 3 - OPERATION

3.02 Voltage, Frequency and Phase Rotation Sensing

A. Programmable voltage and frequency sensing of both sources capable of detecting single or three phase losses. The Controller shall have adjustable pickup and dropout settings for each source. Set point ranges as follows:

Parameter	Sources	Dropout/Trip	Pickup/Reset
Undervoltage	N+E, 3phase	72 to 100%	70 to 98%
Overvoltage	N+E, 3phase	100 to 108%	102 to 110%
Underfrequency	N+E, 3phase	45.1 to 60.0 HZ	45.0 to 59.9 HZ
Overfrequency	N+E, 3phase	50.0 to 69.7 HZ	50.1 to 69.8HZ

B. The controller shall monitor phase rotation of both sources and inhibit transfer if both sources are not the same phase rotation. (ABC or CBA)

C. Settings shall be adjustable in 1% increments either through the keypad, USB port or remotely via communications.

D. A single source status screen shall be provided to allow for viewing of the status of both sources including three phase voltage, power and frequency.

3.03 Time Delays

A. The controller shall include an adjustable time delay of 0 to 10 seconds to momentarily override normal source power outages and to delay engine starting. The time delay shall be expandable up to 60 minutes if an external 24 VDC power supply is provided for ATS control.

B. The controller shall include an adjustable 0 to 60 minute time delay on transfer to emergency, factory set at 3 seconds.

C. The controller shall include a time delay on retransfer to the preferred source adjustable 0 to 259 minutes, factory set at 5 minutes.

D. The controller shall include a time delay on engine cool down adjustable 0 to 60 minutes, factory set at 5 minutes.

E. The controller shall include a timer to control the transition time from neutral to the non-preferred source, adjustable 0 to 10 minutes, factory set at 3 seconds.

F. The controller shall include a timer to control the transition time from neutral to the preferred source, adjustable 0 to 10 minutes, factory set at 3 seconds.

G. All time delays shall be adjustable in 1second increments. All time delays shall be adjustable via the graphical display, the front USB port or configuration software using the USB, serial or Ethernet communications port.

3.04 Additional Features

A. Test Switch – The controller shall be provided with a two position, password protected, test switch to simulate a normal source failure. The test mode shall be configurable for Test Without Load or Test With Load functionality. The Test function shall be activated via the pushbutton on the display or remotely via a dry contact, voltage signal or a network signal.

B. Engine Start Signal – A SPDT contact, rated 10 amps at 30 VDC, shall be provided to start the engine generator in the event of a normal source outage.

C. Source connected contacts rated 10 amps at 120 VAC shall be provided to signal when the ATS is connected to each source.

D. Source Connected LED's – The controller shall include LED's to indicate when the ATS is connected to each source.

E. Source Availability LED's – The controller shall include LED's to indicate the availability of each source.

F. Commit/No-Commit Transfer Selector – The controller shall include a programmable selector to configure the controller to commit to transferring the load to emergency (or not) in the event the normal source returns prior to the generator being ready to accept load.

G. Inhibit Transfer Signals – The controller shall be capable of accepting transfer control inputs that inhibit transfer of the ATS to either source.

H. Auto/Manual Selector – The controller shall include a programmable function to select either Automatic or Manual operation.

I. ATS/Engine Exerciser – The controller shall include a user configurable exerciser. Exerciser shall be configurable for daily, 7 day, 14 day or 28 day exercise periods, each with (7) programmable events. The exerciser shall also be configurable as a full, 365 day exerciser with up to 24 independent exercise events. Each event shall be configurable for Test with Load and Test Without Load. Each event shall include user adjustable start time, date and test duration. All time and date settings shall be stored in non- volatile EEPROM memory. The controller shall include full programmability for daylight savings time.

J. Diagnostics – The controller shall contain self and system diagnostic screens for the purpose of detecting and troubleshooting abnormal system events.

K. Communications Interface – The controller shall be capable of interfacing via serial/RS485 and Ethernet TCP/IP communications ports integral to the controller. All communications parameters (baud rate, parity, IP Address, etc.) shall be accessible and programmable via the front keypad. Both serial and Ethernet communication shall be Modbus open protocol.

L. Event Logger – The controller shall have the ability to log data and to maintain the last 256 events, even in the event of a power failure. Time and date stamping of events will be accurate to 1 ms. Controller shall be capable of synchronizing its date/time setting with a main PC via Network Time Protocol over an Ethernet TCP/IP network connection.

The following events shall be time and date stamped:

1. Last Primary Source Failure
2. Last reason for transfer.
3. Last transfer to alternate source
4. Last retransfer to primary source
5. Time load is without power
6. Time ATS powered up
7. Total time on source 1
8. Total time on source 2
9. Total number of primary source failures
10. Total number of transfers

M. Communications Modules

1. Serial Communications: Controller shall support RS485 communications port to enable serial communications at baud rates up to and including 115.2Kbps and be user configurable. The serial communications shall be capable of a direct connect or multi-drop configured network.
2. Ethernet Communications: Controller shall be capable of supporting an optional Ethernet TCP/IP communications via an internally mounted and self-powered communications card. Ethernet shall be 10/100 Mbit, auto sensing and include a RJ45 network connector.
3. Open Protocol: Both serial and Ethernet communications shall be Modbus protocol. Proprietary communications protocols shall not be acceptable.

N. External Power Supply: The controller shall be capable of being connected to an external 24 VDC power supply to permit full operation and communications of the controller when both sources are de-energized.

O. Auto Load Shed: The controller shall be capable of being programmed to automatically shed the connected load in the event of a user configurable under frequency condition.

P. Customer Configurable Alarms – The controller shall be capable of being configured to display customer configured alarm points. Alarms shall be capable of being reset via a remote contact.

3.05 Power Quality Metering

A. The ATS shall be able to supply metering for current, voltage, real power, reactive power, energy use, power factor and frequency. Metering shall be true RMS type, 1% accuracy for voltage and 0.5% for currents with a 5 amp secondary current transformer.

B. The following parameters shall be provided:
   1. Phase current: Ia, Ib, Ic, In and average current (Iavg)
   2. Phase voltage: Va, Vb, Vc, Vab, Vac, Vbc
   3. Voltage and Current unbalance
   4. Hz, PF, W, Var, VA
   5. Wh, VAh, VARh
   6. Voltage and Current Harmonics (% THD up to 8th order)
   7. Phase Rotation Sensing
   8. Synchroscope (lead/lag)

C. The ATS shall be capable of monitoring and capturing waveform data in the event of a utility power outage or other user specified event.
   1. A total of 10 active channels of waveform capture may be user configured.
   2. Each channel shall be capable of capturing up to 256 cycles of waveform information.
   3. Analog channels may be configured for 4, 8, 16 or 32 samples/cycle.
   4. Digital channels shall be configured for 1 sample/cycle.
   5. Waveform data shall be stored in industry standard COMTRADE format for broadest compatibility and ease of downloading to a PC.

D. The controller shall be capable of logging digital and analog measured parameters and storing the data in non-volatile memory.
   1. The controller shall contain a 10 channel Data Logger. Each channel shall be capable of being configured to monitor a digital on/off or analog measured parameter.
   2. The sampling rate of each channel shall be configurable form 1 cycle to 60 minutes per sample. The data shall be stored in non-volatile memory in a first in, first out method.

PART 4 - ADDITIONAL REQUIREMENTS

4.02 Withstand and Close Ratings

A. The ATS shall be UL listed in accordance with UL 1008 for 3 cycle close and withstand ratings. ATS's that are not tested and labeled for 3 cycle, ratings are not acceptable. Minimum UL listed close and withstand ratings at 480 VAC shall be as follows:

Size Amps	3 Cycle	Current Limiting Fuses
100 - 400	42 Ka	200,000 Ka
600 – 800	65 Ka	200,000 Ka
1000 – 1200	85 Ka	200,000 Ka

1600 – 4000	100 Ka	200,000 Ka

B. During 3 cycle closing and withstand tests, there shall be no contact welding or damage. The 3 cycle test shall be performed without the use of current limiting fuses. The tests shall verify that contact separation has not occurred, and there is contact continuity across all phases. Test procedures shall be done in accordance with UL-1008, and testing shall be certified by Underwriters Laboratories, Inc.

C. When conducting temperature rise tests to UL-1008, the manufacturer shall include post-endurance temperature rise tests to verify the ability of the ATS to carry full rated current after completing the overload and endurance tests.

4.03 Manufacturer

A. The Transfer Switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24 hours a day, 365 days a year call basis.

B. The manufacturer shall include an 800-telephone number, for field service contact, affixed to the outside of each enclosure.

C. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum of 20 years.

D. ATS Shall be provided with manufactures standard parts, labor and travel warranty for the duration of 5 years from date of shipment.

4.04 Installation

A. Automatic Transfer Switches shall be provided with adequate lifting means for ease of installation of wall or floor mounted enclosures.

B. Provide access and working space as indicated or required.

4.05 Testing

A. See generator specifications sub section “MANUFACTURER’S FIELD SERVICES” for testing requirements of automatic transfer switch.

END OF SECTION 26 36 33

SECTION 26 41 13

LIGHTNING PROTECTION FOR STRUCTURES

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 lightning protection for structures, structure elements, and building site components.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For air terminals and mounting accessories.

1. Layout of the lightning protection system, along with details of the components to be used in the installation.
2. Include indications for use of raceway, data on how concealment requirements will be met, and calculations required by NFPA 780 for bonding of grounded and isolated metal bodies.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer. Include data on listing or certification by UL.

B. Certification, signed by Contractor, that roof adhesive is approved by manufacturer of roofing material.

C. Field quality-control reports.

D. Comply with recommendations in NFPA 780, Annex D, "Inspection and Maintenance of Lightning Protection Systems," for maintenance of the lightning protection system.

E. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features, including the following:

1. Ground rods.

2. Ground loop conductor.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Certified by UL or LPI as a Master Installer/Designer, trained and approved for installation of units required for this Project.

B. System Certificate:

1. UL Master Label.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 780, "Definitions" Article.

1.6 COORDINATION

A. Coordinate installation of lightning protection with installation of other building systems and components, including electrical wiring, supporting structures and building materials, metal bodies requiring bonding to lightning protection components, and building finishes.

B. Coordinate installation of air terminals attached to roof systems with roofing manufacturer and Installer.

C. Flashings of through-roof assemblies shall comply with roofing manufacturers' specifications.

PART 2 - PRODUCTS

2.1 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Comply with UL 96 and NFPA 780.

B. Roof-Mounted Air Terminals: NFPA 780, Class I, copper unless otherwise indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. East Coast Lightning Equipment Inc.
b. ERICO International Corporation.
c. Harger.
d. Heary Bros. Lightning Protection Co. Inc.
e. Independent Protection Co.
f. Preferred Lightning Protection.
g. Robbins Lightning, Inc.
h. Thompson Lightning Protection, Inc.

2. Air Terminals More than 24 Inches Long: With brace attached to the terminal at not less than half the height of the terminal.

3. Single-Membrane, Roof-Mounted Air Terminals: Designed specifically for single-membrane roof system materials. Comply with requirements in roofing Sections.

C. Main and Bonding Conductors: Copper.

D. Ground Loop Conductor: The same size and type as the main conductor except tinned.

E. Ground Rods: Copper-clad steel; 3/4 inch in diameter by 10 feet long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install lightning protection components and systems according to UL 96A and NFPA 780.

B. Install conductors with direct paths from air terminals to ground connections. Avoid sharp bends.

C. Conceal the following conductors:

1. System conductors.
2. Down conductors.
3. Interior conductors.
4. Conductors within normal view of exterior locations at grade within 200 feet of building.

D. Cable Connections: Use crimped or bolted connections for all conductor splices and connections between conductors and other components. Use exothermic-welded connections in underground portions of the system.

E. Air Terminals on Single-Ply Membrane Roofing: Comply with roofing membrane and adhesive manufacturer's written instructions.

F. Bond extremities of vertical metal bodies exceeding 60 feet in length to lightning protection components.

G. Ground Loop: Install ground-level, potential equalization conductor and extend around the perimeter of structure.

1. Bury ground ring not less than 24 inches from building foundation.
2. Bond ground terminals to the ground loop.
3. Bond grounded building systems to the ground loop conductor within 12 feet of grade level.

H. Bond lightning protection components with intermediate-level interconnection loop conductors to grounded metal bodies of building at 60-foot intervals.

3.2 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.3 CORROSION PROTECTION

A. Do not combine materials that can form an electrolytic couple that will accelerate corrosion in the presence of moisture unless moisture is permanently excluded from junction of such materials.

B. Use conductors with protective coatings where conditions cause deterioration or corrosion of conductors.

3.4 FIELD QUALITY CONTROL

A. Notify Architect at least 48 hours in advance of inspection before concealing lightning protection components.

B. UL Inspection: Meet requirements to obtain a UL Master Label for system.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.

1.3 DEFINITIONS

A. Inominal: Nominal discharge current.

B. MCOV: Maximum continuous operating voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent protective device.

F. SCCR: Short-circuit current rating.

G. SPD: Surge protective device.

H. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

3. Complete with all technical information, unit dimensions, detailed installation instructions, maintenance manual, recommended replacement parts list and wiring configuration.
4. Manufacturer's catalog data, technical information and specifications on equipment proposed for use.
5. Documentation stating that the Surge Protection Device is listed by UL to UL1449 3rd Edition, category code VZCA.
6. Actual let-through voltage data in the form of oscillograph results for both ANSI/IEEE C62.41 Category C3 (combination wave) and B3 (Ring wave) tested in accordance with ANSI/IEEE C6245.
7. Noise Rejection testing as outlined in NEMA LS1-1992 (R2000) Section 3.11. Noise rejection is to be measured between 50kHZ and 100MHz verifying the devices noise attenuation. Show multiple attenuation levels over a range of frequencies.
8. Test reports from a recognized independent testing laboratory, capable of producing 200kA surge current waveforms, verifying the suppressor components can survive published surge current rating on a per mode basis using the ANSI/IEEE C62.41 impulse waveform C3 (8 x 20 microsecond, 20kV/10kA). Test data on an individual module is not acceptable.
9. Warranty statement clearly establishing the terms and conditions to the building/facility owner/operator.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Sample Warranty: For manufacturer's special warranty.

1.6 QUALITY ASSURANCE

A. SPD with Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Service entrance type surge protection devices suitable for use as Type 1 or Type 2 devices per UL1449 3rd Edition, applied to the line or load side of the utility feed inside the facility.

D. MCOV of the SPD shall be the nominal system voltage.

E. UL 1283.

F. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

G. ANSI/IEEE C62.45, Guide for Surge Testing for equipment connected to Low-Voltage AC Power Circuits.

H. UL96A

I. IEEE 1100 Emerald Book.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For SPDs to include in maintenance manuals.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SERVICE ENTRANCE SUPPRESSOR

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Current Technologies or Engineer-approved equal.

B. For approved equivalent. 2 weeks prior to bid, submit package to engineer date demonstrating compliance with all performance characteristics included in this specification, parapgraph-by-pragraph.

C. Refer to drawings for operating voltage.

D. Declared Maximum Continuous Operating Voltage (MCOV) shall above 115 percent of the nominal system operating voltage and in compliance with test and evaluation procedures outlined in the nominal discharge surge current test of UL1449 3rd Edition, section 37 .7 .3. MCOV values claimed based on the component’s value or on the 30-minute 115% operational voltage test, section 38 in UL1449 are not be acceptable.

E. When exposed to a minimum of 14,000 repeated category C3 (20kV/10kA) surges, less than 10% deterioration or degradation of the UL1449 3rd Edition Voltage Protection Rating (VPR) . Provide a test report validating the repetitive surge tests performed.

F. Protection Modes UL1449 3rd Edition VPR(6kV, 3kA) for grounded WYE/delta and High Leg Delta circuits with voltages of (480Y/277), (208Y/120), (600Y/347). 3-Phase, 4 wire circuits, (120/240) split phase shall be as follows and comply with test procedures outlined in UL1449 3rd Edition section 37.6:

System	Mode	MCOV	B3 Ringwave 6kV, 500A	C3 Comb. Wave 20kV, 10kA	UL 1449 Third Edition VPR Rating
120/240, 208Y120V	L-N	150	490	980	700
	L-G	150	570	980	700
	N-G	150	640	1170	700
	L-L	300	500	1600	1200
480Y/277V	L-N	320	450	1420	1200
	L-G	320	540	1540	1200
	N-G	320	570	1600	1000
	L-L	552	530	2600	2000

G. Electrical Noise Filter- high performance EMI/RFI noise rejection filter with a maximum attenuation of 54dB per MIL-STD-220B. Include a EMI/RFI noise rejection filter for all L-N modes as well as a removable filter in the N-G mode.

H. Capable of preventing common temporary overvoltages and high impedance faults from damaging MOVs, increasing their longevity and ability to protect the critical load. Limited and Intermediate current TOVs (as specified in UL 1449 article 39.3 and 39.4) caused by a loss of the neutral conductor in a split phase or three phase power system. Available fault current determined by the impedance of the loads connected to the phases opposite the SPD and typically in the range of 30A to 1000A.

I. Selenium elements must limit voltage to the MOV as a percent of nominal as outlined below:

Overvoltage seen by MOVs as % of Nominal available current

time	30A	100A	500A	1000A
1 cycle	120%	130%	150%	160%
10 cycles	130%	150%	160%	160%
30 cycles	140%	150%	160%	160%

*To verify damage to the MOVs has been mitigated, the percent overvoltage seen at the MOV must be less than 200% for split-phase applications or 173% for three-phase applications (100% is nominal).

J. Withstand multiple TOVs without damage to the MOVs by shunting current away from the MOVs during the overvoltage. Ability to withstand >100 TOVs with a source current of 30A, duration of 30 cycles, with10s between TOV events.

K. For service entrance protector, incorporate a combination of TPMOV and Selenium technology allowing for transient surge and temporary over voltage protection.

L. Integral Disconnect Switch.

M. NEMA compliant safety interlocked integral disconnect switch with an externally mounted metal manual operator, capable of disconnecting all ungrounded circuit conductors from the distribution system to enable testing and maintenance without interruption to the facility's distribution system. Rated for 600Vac.

N. Tested to UL1449 3rd Edition listed with the integral disconnect switch and the UL1449 VPR ratings shall be provided.

O. Integral disconnect switch shall be capable of withstanding, without failure, the published maximum surge current magnitude without failure or damage to the switch.

P. Line side of the integral disconnect shall be barriered so that when the SPD is opened, no direct access to the voltage is possible.

Q. UL1449 Voltage Protective Rating (VPR) shall be permanently affixed.

R. UL1449 Nominal Discharge Surge Current Rating shall be 20kA.

S. SCCR rating of 200kAIC without the need for upstream over current protection.

T. Listed as Type1 SPD, suitable for use in Type1 or Type2 applications.

U. Provide following monitoring options.
1. Time Date stamp, duration and magnitude for the following power quality events (sags, swells, surges, dropouts, outages, THD, frequency, Volts RMS per phase)
2. Track surge protection and display it as a percentage of remaining protection.
3. Surge counter with three categories to be defined as:
   a. Low Level surge (100A-500A).
   b. Medium Level surge (500A-3,000A).
   c. High Level surge (>3,000A)
4. Remote communications via ModBus or Ethernet
5. Form-C contacts rated at 2 A and 24-V ac, one normally open and one normally closed, for remote monitoring of protection status.

2.2 ENCLOSURES

A. Indoor Enclosures: NEMA 250, Type 1.

2.3 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

B. If installed lead length exceeds 5’6”, use low impedance (HPI) cable.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.

C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible, and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not

splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

D. Use crimped connectors and splices only. Wire nuts are unacceptable.

E. Wiring:

1. Power Wiring: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
2. Controls: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Compare equipment nameplate data for compliance with Drawings and Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. An SPD will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks according to manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests, and reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

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. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

PART 2 - Related Sections: GENERAL

2.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

2.2 SUMMARY

A. Section includes the following types of LED luminaires:

1. Cylinder.
2. Downlight.
3. Highbay, linear.
4. Recessed linear.
5. Strip light.
6. Surface mount, linear.
7. Surface mount, nonlinear.
8. Suspended, linear.
9. Suspended, nonlinear.
10. Materials.
11. Finishes.
12. Luminaire support.

2.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

2.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

2.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches (300 mm) of the plane of the luminaires.

4. Structural members to which equipment or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Smoke and fire detectors.
    f. Occupancy sensors.
    g. Access panels.
    h. Ceiling-mounted projectors.

7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

F. Sample warranty.

2.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

2.7 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. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

2.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

2.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

2.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 3 - PRODUCTS

3.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

3.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Standards:

1. ENERGY STAR certified.
2. UL Listing: Listed for damp location.
3. Recessed luminaires shall comply with NEMA LE 4.
4. User Replaceable Lamps (where applicable):

a. Bulb shape complying with ANSI C78.79.

b. Lamp base complying with ANSI C81.61 or IEC 60061-1.

C. CRI of minimum 80. CCT per light fixture schedule on drawings.

D. Rated lamp life of 50,000 hours to L70.

E. Lamps dimmable from 100 percent to 0 percent of maximum light output.

F. Internal driver.

G. Nominal Operating Voltage: 120 V ac or 277 V ac.

1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

H. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear anodized powder-coat painted finish.

3.3 DOWNLIGHTS

A. Lithonia Lighting or TxDOT approved equal.

B. Nominal Operating Voltage: Mulit-Volt

C. Lamp:
1. Minimum 2000 lm.
2. Minimum allowable efficacy of 80 lm/W.
3. CRI of minimum 80. CCT of 4000K.
4. Rated lamp life of 50,000 hours to L70.
5. Dimmable from 100 percent to zero percent of maximum light output.
6. Internal driver.
7. User-Replaceable Lamps:
   a. Bulb shape complying with ANSI C78.79.
   b. Lamp base complying with ANSI C81.61.
8. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:
1. Galvanized steel housing and heat sink.
2. Finish as direct by architect.
3. Universal mounting bracket.
4. Integral junction box with conduit fittings.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers:
1. Concealed diffusing optical lens.

2. Medium light distribution.
3. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
4. Glass: Annealed crystal glass unless otherwise indicated.
5. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

G. Standards:
1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.
4. Recessed luminaires shall comply with NEMA LE 4.

3.4 HIGHBAY

A. Lithonia Lighting or TxDOT approved equal.

B. Nominal Operating Voltage: Multi-Volt

C. Lamp:
1. Minimum 18,000 lm.
2. Minimum allowable efficacy of 80 lm/W.
3. CRI of minimum 80. CCT of 4000K.
4. Rated lamp life of 50,000 hours to L70.
5. Dimmable from 100 percent to zero percent of maximum light output.
6. Internal driver.
7. User-Replaceable Lamps:
   a. Bulb shape complying with ANSI C78.79.
   b. Lamp base complying with ANSI C81.61.
8. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:
1. One-piece 5VA rated fiberglass housing with continuous poured-in-place, closed cel gasket with three piece captive latches.
2. Finish as direct by architect.
3. With integral mounting provisions.
4. Wet location rated.
5. IP65

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers:
1. Injection-molded Acrylic Diffusers: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation. Impact resistant.
2. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

G. Standards:

1. RoHS compliant.
2. UL Listing: Listed for Wet location.

3.5 WASH BAY WALL PACK

A. Lithonia Lighting or TxDOT approved equal.

B. Nominal Operating Voltage: Multi-Volt

C. Lamp:
1. Minimum allowable efficacy of 80 lm/W.
2. CRI of minimum 80. CCT of 4000K.
3. Rated lamp life of 50,000 hours to L70.
4. Dimmable from 100 percent to zero percent of maximum light output.
5. Internal driver.
6. User-Replaceable Lamps:
   a. Bulb shape complying with ANSI C78.79.
   b. Lamp base complying with ANSI C81.61.
7. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:
1. Corrosion-Resistant, die-cast aluminum, with corrosion
2. Wet location rated.
3. IP65

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers:
1. Specular anodized aluminum reflector.
2. Refractor is prismatic borosilcate glass, sealed and gasketed.
3. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

G. Standards:
1. RoHS compliant.
2. UL Listing: Listed for Wet location.

3.6 RECESSED

A. Lithonia Lighting or TxDOT approved equal.

B. Nominal Operating Voltage: Multi-Volt

C. Lamp:
1. Minimum 4800 lm.
2. Minimum allowable efficacy of 85 lm/W.

3. CRI of minimum 80. CCT of 4000K.
4. Rated lamp life of 50,000 hours to L70.
5. Dimmable from 100 percent to zero percent of maximum light output.
6. Internal driver.
7. User-Replaceable Lamps:
   a. Bulb shape complying with ANSI C78.79.
   b. Lamp base complying with ANSI C81.61.
8. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:
1. One-Piece cold-rolled steel coated plyester
2. Finish as directed by architect.
3. With integral mounting provisions.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers:
1. White Satin Lens
2. Wide distribution

G. Standards:
1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.
4. NEMA LE 4.

3.7 STRIP LIGHT

A. Lithonia Lighting or TxDOT approved equal.

B. Nominal Operating Voltage: Multi Volt

C. Lamp:
1. Minimum 5000 lm.
2. Minimum allowable efficacy of 80 lm/W.
3. CRI of minimum 80. CCT of 4000K.
4. Rated lamp life of 50,000 hours to L70.
5. Dimmable from 100 percent to zero percent of maximum light output.
6. Internal driver.
7. User-Replaceable Lamps:
   a. Bulb shape complying with ANSI C78.79.
   b. Lamp base complying with ANSI C81.61.
8. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

D. Housings:
1. Code-Gauge cold-rolled steel

2. Finish as directed by architect
3. With integral mounting provisions.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping of luminaire without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. Diffusers:
1. Snap on/Snap off acrylic lens
2. Lens Thickness: At least 0.125-inch minimum unless otherwise indicated.

G. Standards:
1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.
4.

3.8 LED EMERGENCY LIGHTING FIXTURES

A. Internal Type: Self-contained, modular, LED emergency driver battery-inverter unit factory mounted within fixture body. Comply with UL 924.

1. Emergency Connection (Switched Fixture): Connect unswitched circuit to LED emergency driver battery-inverter unit and switched circuit to normal driver.
2. Night Light Connection: Connect unswitched circuit to both LED emergency driver battery-inverter unit and normal driver.
3. Test Switch and Light-Emitting-Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
4. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
5. Charger: Fully automatic, solid-state, constant-current type.

B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more LED light fixtures, remote mounted from light fixture. Comply with UL 924.

1. Emergency Connection (Switched Fixture): Connect unswitched circuit to LED emergency driver battery-inverter unit and switched circuit to normal driver.
2. Night Light Connection: Connect unswitched circuit to both LED emergency driver battery-inverter unit and normal driver.
3. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum seven-year nominal life.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Class 1 enclosure.

3.9 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Tempered Fresnel glass, prismatic glass, diffuse glass, clear glass, prismatic acrylic, or clear, UV-stabilized acrylic.
2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
3. Glass: Annealed crystal glass unless otherwise indicated.
4. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Clear anodized powder-coat painted finish.

E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI for all luminaires.

3.10 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

3.11 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 4 - EXECUTION

4.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation. Proceed with installation only after unsatisfactory conditions have been corrected.

4.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting.

4.3 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

G. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches (6 m) in length.

H. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

4.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

4.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

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. Luminaire-mounted photoelectric relays.
   2. Poles and accessories.
   3. Luminaire lowering devices.

B. Related Sections:

   1. Section 26 51 00 "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Luminaire: Complete lighting fixture.

E. Pole: Luminaire support structure, including tower used for large area illumination.

F. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.

B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4-M.

C. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.

1. Basic wind speed for calculating wind load for poles 50 feet high or less is 150 mph.

a. Wind Importance Factor: 1.0.
b. Minimum Design Life: 25 years.
c. Velocity Conversion Factors: 1.0.

1.5 ACTION SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps and accessories.

a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
8. Materials, dimensions, and finishes of poles.
9. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
10. Anchor bolts for poles.
11. Manufactured pole foundations.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
3. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires, poles, and photoelectric relays to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with IEEE C2, "National Electrical Safety Code."

E. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements:
   1. Lithonia Lighting
   2. TxDOT approved Equal

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

C. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

D. Lamp base complying with ANSI C81.61.

E. L70 lamp life of 50,000 hours.

F. Lamps dimmable from 100 percent to 0 percent of maximum light output.

G. Internal driver.

H. Metal Parts: Free of burrs and sharp corners and edges.

I. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.

J. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

K. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

L. Exposed Hardware Material: Stainless steel.

M. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

N. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

O. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

P. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

Q. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

R. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As specified on plans.

S. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

    a. Color: As specified on plans.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

A. Comply with UL 773 or UL 773A.

B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time

delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.

1. Relay with locking-type receptacle shall comply with ANSI C136.10.
2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

A. Area and Site:
1. Lithonia Lighting or TxDOT approved equal.
2. Luminaire Shape: Modern style
3. Mounting: Pole
4. Luminaire-Mounting Height: 20 feet
5. Distribution: As indicated on photometrics included in construction drawings.
6. Diffusers: Precision-molded, Acrylic Lenses, UV Stabilized, with zero uplight
7. Housings:
   a. Single piece die-cast aluminum housing/heat sink with LED driver in direct contact for low operating temperatures
   b. Zinc-Infused Super Durable TGIC thermoset powder coat finish.

B. Wall Pack:
1. Lithonia Lighting or TxDOT approved equal.
2. Luminaire Shape: Modern Style
3. Mounting: Building
4. Luminaire-Mounting Height: 10 Feet, coordinate mounting heights with architect.
5. Distribution: As indicated on photometrics included in construction drawings.
6. Diffusers: Precision-molded, Acrylic Lenses, UV Stabilized
7. Housings:
   a. Two-Piece die-cast aluminum housing and heat sink. LED driver mounted to door for thermal isolation.
   b. Zinc-Infused Super Durable TGIX thermoset powder coat finish.

C. Bollard:
1. Lithonia Lighting or TxDOT approved equal.
2. Shape: Round top with four-point star shaft
3. Height Above Finished Grade: 36”
4. Diameter: 7”
5. Mounting: Four anchor bolts with double nuts and washers.
6. Distribution: As indicated on photometrics included in construction drawings.
7. Optics: LED light engine with smoothly graduated illumination
8. Housings:
   a. Single piece extruded aluminum shaft with thick side walls.
   b. Die-cast reflector and top cap.
   c. Zinc-Infused Super Durable TGIC thermoset powder coat finish.

2.5 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

A. Structural Characteristics: Comply with AASHTO LTS-4-M.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Handhole: Oval-shaped, with minimum clear opening of 2-1/2 by 5 inches, with cover secured by stainless-steel captive screws.

E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Section 03 30 00 "Cast-in-Place Concrete."

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

2.6 STEEL POLES

A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig; one-piece construction up to 40 feet in height with access handhole in pole wall.

1. Shape: As specified on plans.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

B. Steel Mast Arms: Truss type, continuously welded to pole attachment plate. Material and finish same as pole.

C. Brackets for Luminaires: Detachable, cantilever, without underbrace.

1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with stainless-steel bolts.
2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.

3. Match pole material and finish.

D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

E. Steps: Fixed steel, with nonslip treads, positioned for 15-inch vertical spacing, alternating on opposite sides of pole; first step at elevation 10 feet above finished grade.

F. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

G. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

H. Platform for Lamp and Ballast Servicing: Factory fabricated of steel with finish matching that of pole.

I. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

J. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

K. Factory-Painted Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
3. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.

    a. Color: As specified on plans

2.7 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: As specified on plans.
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
2. Finish: As specified on plans.

F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. As specified on plans.

a. Color: As specified on plans.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

3.2 POLE INSTALLATION

A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches.
2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
3. Trees: 15 feet from tree trunk.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Section 03 30 00 "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers unless otherwise indicated.
4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.

F. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 03 30 00 "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 26 05 33 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

A. Ground metal poles and support structures according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.

3.7 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):

a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
d. IESNA LM-64, "Photometric Measurements of Parking Areas."
e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices.

END OF SECTION

SECTION 27 13 43

TELECOMMUNICATIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. This section identifies the contractor's general requirements and specifications for the structured cabling system as specified by industry and manufactures standards, at the Texas Department of Transportation.

1.2 EXPERIENCE REQUIREMENTS

A. The Contractor shall possess all relevant Manufacturer Certifications (i.e.structured cable systems, testing equipment, etc.,) for both the company and individual technicians prior to submitting a bid for the work.

B. The Contractor shall provide verification of certifications prior to starting work.

C. The Contractor shall have an adequate workforce to complete the project, located or housed within a 75 mile radius of the site.

D. The Contractor shall have in their possession all of the tools, test equipment, and resources necessary to complete the job prior to the start of work.

E. The Contractor shall have been in business for a minimum of five (5) years.

F. The Contractor shall have completed a minimum of five (5) projects similar in size and scope to the Owner's installation, where the systems have been in continuous satisfactory operation for at least one (1) year.

G. The Contractor's Project Manager shall be a Registered Communications Distribution Designer (RCDD) and available for all onsite coordination meetings.

1.3 SUBCONTRACTORS REQUIREMENTS

A. Subcontractors shall be identified at the time of bid.

B. Subcontractors shall comply with all of the requirements, specifications, and standards outlined in this document

1.4 RELATED REQUIREMENTS

A. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 1 apply to the work specified in Division 27, and shall be complied with in every respect.

B. The Contractor shall examine all of the items which make up the Contract Documents, and shall coordinate them with the work on the project.

C. The Contractor shall provide a Manufacturer's 20-Year Performance Certification for the installed structured cabling system.

D. Contractor shall include materials, equipment, and labor necessary to provide a complete and functional structured cabling system regardless of any items not listed or described in this specification or associated drawings.

1.5 SUBMITAL REQUIREMENTS

A. Pre-Installation Submittal
1. Contractor shall not order, purchase, or install any equipment until the Architect/Engineer has accepted pre-installation submittals in writing.
2. All submittals shall be submitted in the same sequence as they are listed in the specifications (i.e. product data in the sequence items are listed in the product data section, manufacturer product certifications for company, manufacturer product certifications for installers, etc.). Submittals not in the proper sequence will not be approved.
3. Manufacturer product data sheets for each proposed system component.
   a. For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or product being submitted. Product data sheets without the part number clearly identified will not be approved.
4. Manufacturer Product Certifications for Company.
5. Manufacturer Product Certifications for Installers.
6. Manufacturer Certifications for testing equipment technicians.
7. Manufacturer Certifications for testing equipment calibration.
8. RCDD Certificate for Contractor's Project Manager.
9. Manufacturer Warranty letter.
10. Documentation that Contractor has been in business for (5) years.
11. Address of Contractor's local office within a 75-mile radius of the project site, and quantity of full time local technicians within a 75-mile radius of the project site.
12. List of five (5) contractor-installed projects of a similar size and scope that have been in operation for at least (1) year. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
13. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.
14. List of subcontractors performing any work on the project. List shall clearly identify the subcontractor's legal name and address, the scope of work to be performed by the subcontractors and the overall percentage of the project being provided by the subcontractor. If there are no subcontractors performing any

work on the project, submit a statement on company letterhead clearly indicating no subcontractors will be performing any work on this project.

PART 2 PRODUCTS

2.1 GENERAL

A. The Following section lists the acceptable equipment and manufactures for all Texas Department of Transportation projects.

2.2 GENERAL REQUIREMENTS

A. Architect/Engineer will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.

B. Proposed equivalent items must be approved in writing by the Architect/Engineer prior to purchase or installation. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.

C. In the event a manufacturer's specified product or part number has changed or is no longer available, Contractor shall substitute the appropriate equivalent manufacturer's part number.

D. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished.

E. For listed products with no part number specified, Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.

F. All wiring, equipment, and installation materials shall be new and of the highest quality.

G. Labels on all cabling, materials, and equipment must indicate a nationally recognized testing laboratory.

H. Original Equipment Manufacturer (OEM) documentation must be provided to the Architect/Engineer which certifies performance characteristics and compliance with ANSI/TIA/EIA 568-C standards.

2.3 ACCPTABLE MANUFACTURERS

A. Fiber Optic Backbone Cable
   1. Outdoor Underground
      a. 50/125 µm Laser Optimized Outdoor Multi-mode 12 Strand Armored
         1) Berk-Tek Adventum Part Number – LTPK12B012EB3010/25
         2) Approved Equal
      b. 9/125µm Indoor/Outdoor Single-Mode 12 Strand Armored
         1) Berk-Tek Adventum Part Number – LTPK12B012AB0403
         2) Approved Equal

c. Fiber Optic Innerduct
1) Indoor Plenum Rated
a) MaxCell 2" 3-Cell, 250 feet spool – Part Number – MXP2003XX250 (XX=color)
b) Approved Equal
2) Outdoor (Orange)
a) Carlon
b) Approved Equal

B. Copper Backbone Cable
1. Indoor
2. Outdoor Underground
a. PE-89 24 AWG Unshielded Twisted Pair (UTP) OSP
1) Superior Essex Part Number – 50-Pair - 09-100-02
2) Approved Equal

C. Horizontal Cable
1. Category 6 UTP Plenum
a. Network Access (Blue Sheath)
1) Berk-Tek LANmark-2000 Part Number – 10163222
2) Approved Equal
2. Wireless Access Points (Green Sheath)
a. Berk-Tek LANmark-2000 Part Number – 10170668
b. Approved Equal
3. Category 6 UTP Flooded
a. OSP (Black Sheath)
1) Berk-Tek LANmark-6 OSP UTP Part Number – 10139885
2) Approved Equal

D. Fiber Optic Cable Termination
1. Enclosure
a. 2U Fiber Enclosure
1) Leviton Opt-X 1000i Rack Mounted Fiber Optic Enclosure – Part Number 5R2UM-S18
2) Approved Equal
2. Fiber Adapter Plates
a. 9µm Single-Mode Fiber Adapter Plate
1) Leviton Opt-X Single-mode OS1/2, Quad LC, 12 fibers, Zirconia Ceramic Sleeve Blue – Part Number – 5F100-4LL
b. 50µm Multi-Mode Fiber Adapter Plate
1) Leviton Opt-X 50/125 um Multimode Laser Optimized OM3/4, Quad LC, 12 fibers, Zirconia Ceramic Sleeve Aqua –Part Number – 5F100-4QL
3. Fiber Blank Plate
a. Leviton OPT-X Blank Metal Adapter Plate – Part Number 5F100-BLK
4. 9µm Single-Mode LC Connectors
a. Leviton FASTCAM LC Single-mode Connector, Blue – Part Number – 49991-SLC
5. 50µm Multi-Mode LC Connectors

a. Leviton FASTCAM LC 50/125um Laser Optimized Multimode Connector, Aqua – Part-Number-49991-LLC
b. Approved Equal

6. Loose Tube Fiber Fan-Out Kit
   a. Leviton 24" Fiber Optic Fan-Out Kit, 12-fiber –Part Number – 49887-12S
   b. Approved Equal

E. Copper Cable Termination
1. Building Entrance Terminals
   a. Primary Copper Protectors (on each end of any outdoor copper)
      1) Circa 50-Pair 110 Style Lightning Protection Block – Part Number – 1880ENA1/NSC-50
      2) Category 6 POE Rated Lightning Protection – ITW LINX – CAT6-POE
      3) Approved Equal
2. Backbone Cable Termination Panels
   a. Rack Mounted Voice Patch Panels
      1) Leviton 1RU 24-Port QuickPort Flat Panel (Empty) –Part Number 49255-H24
      2) Leviton 2RU 48-Port QuickPort Flat Panel (Empty) –Part Number 49255-H48
      3) Approved Equal
3. Category 6 Horizontal Rack Mounted Patch Panels
   a. Panels
      1) Leviton 1RU 24-Port QuickPort Flat Panel (Empty) –Part Number 49255-H24
      2) Leviton 2RU 48-Port QuickPort Flat Panel (Empty) –Part Number 49255-H48
      3) Approved Equal
4. Category 6 Modular Jacks
   a. Network Access
      1) Equipment Room/Telecommunications Room End (Black)
         a) Leviton QuickPort eXtreme 6+ CAT 6 Connector –Part Number 61110-RE6
         b) Approved Equal
      2) Field End (Blue)
         a) Leviton QuickPort eXtreme 6+ CAT 6 Connector –Part Number 61110-RL6
         b) Approved Equal
   b. Wireless Access Points
      1) Equipment Room/Telecommunications Room End (Black)
         a) Leviton QuickPort eXtreme 6+ CAT 6 Connector –Part Number 61110-RE6
         b) Approved Equal
      2) Field End (Green
         a) Leviton QuickPort eXtreme 6+ CAT 6 Connector –Part Number 61110-RV6
         b) Approved Equal

c. IP Security
1) Equipment Room/Telecommunications Room End (BLACK)
a) Leviton QuickPort eXtreme 6+ CAT 6 Connector – Part Number 61110-RE6
b) Approved Equal
2) Field End (Yellow)
a) Leviton QuickPort eXtreme 6+ CAT 6 Connector –Part Number 61110-RY6
b) Approved Equal

5. Telecommunications Faceplates with Designation Window
a. 2-Port Single Gang Flush (Stainless Steel)
1) Leviton QuickPort Stainless Steel Wallplate with ID Window – Part Number 43080-1L2
2) Approved Equal
b. 4-Port Single Gang Flush (Stainless Steel)
1) Leviton QuickPort Angled Stainless Steel Wallplate with ID Window – Part Number 43081-1L4
2) Approved Equal
c. 1-Port Surface Mount Box (White)
1) Leviton QuickPort Surface Mount Box –Part Number 41089-1WP
2) Approved Equal
d. Blank Insert (White)
1) Leviton QuickPort Blank Insert – Part Number 41084-BWB
2) Approved Equal

F. Equipment Racks, Cabinets, Cable Management, and Accessories
1. Two-Post Rack - 19” x 84” Open Frame (Black)
a. Chatsworth – Part Number 55053-703
b. Approved Equal
c. 23” – 19” Rail Adapter Kit
1) Chatsworth – Part # 10587-701
2) Approved Equal
2. Wall Mounted Telecom Rack
a. Black Box part # EWM20U362424 With Cooling Fans Part # RMT373
b. Tripplite part # SRW18US With Cooling Fans SRFANWM
c. Approved Equal
3. Vertical Cable Managers (Black)
a. Chatsworth Double Sided Vertical cabling Section –Part Number 11729-703
b. Approved Equal
4. Horizontal Cable Managers (Black)
a. Chatsworth Rack Cabling Manager - Part Number 11753-719
b. Approved Equal
5. Vertical Power Strip for 7’ Equipment Rack (one at each rack location)
a. Chatsworth Managed 24 Outlet (5-20R) Power Strip with Meter and NEMA 5-20P Input – Part Number P6-1C0A5
b. Approved Equal

6. Horizontal Power Strip for Equipment Racks
   a. Tripp lite Managed 16 Outlet (5-20R) Power Strip with Meter and NEMA 5-20P Input – Part Number PDUMH20NET
   b. Approved Equal

G. Cable Runway (Ladder Type)
1. Universal Cable Runway
   a. 12-inch Chatsworth –Part Number 10250-712
   b. Approved Equal
2. Cable Runway Radius Drop, Cross Member
   a. 12-inch Chatsworth - Part Number 12100-712
   b. Approved Equal
3. Cable Runway Radius Drop, Stringer
   a. Chatsworth - Part Number 12101-701
   b. Approved Equal
4. Cable Runway Butt-Splice Kit
   a. Chatsworth - Part Number 11301-701
   b. Approved Equal
5. Cable Runway Junction-Splice Kit
   a. Chatsworth - Part Number 11302-701
   b. Approved Equal
6. Cable Runway Butt-Swivel Splice Kit
   a. Chatsworth - Part Number 10487-701
   b. Approved Equal
7. Rack-to-Runway Mounting Kit
   a. 9 to 12-inch runway Chatsworth - Part Number 10595-712
   b. Approved Equal
8. Cable Runway Elevation Kit for Racks
   a. Chatsworth – Part Number 10506-706
   b. Approved Equal
9. Cable Runway Elevation Kit for Cabinets
   a. Chatsworth - Part Number 10506-716
   b. Approved Equal
10. Triangular Support Bracket, Aluminum
   a. 6 to 12-inch runway Chatsworth - Part Number 11312-712
   b. 12 to 18-inch runway Chatsworth - Part Number 11421-718
   c. Approved Equal
11. Wall Angle Support Kit, Cable Runway
   a. 12-inch runway Chatsworth - Part Number 11421-712
   b. Approved Equal
12. 90 Degree Runway-Splice Kit
   a. Chatsworth - Part Number 11314-701
   b. Approved Equal
13. 45 Degree Runway-Splice Kit
   a. Chatsworth - Part Number 11313-701
   b. Approved Equal
14. Foot Kit, Cable Runway
   a. Chatsworth - Part Number 11309-001
   b. Approved Equal

15. Vertical Wall Brackets (pair)
    a. Chatsworth - Part Number 10608-701
    b. Approved Equal
16. Threaded Ceiling Kit, Cable Runway
    a. Chatsworth - Part Number 11310-001
    b. Approved Equal
17. Threaded Rod Cover
    a. Chatsworth - Part Number 11085-001
    b. Approved Equal
18. Protective End Caps for Cable Runway
    a. Chatsworth - Part Number 10642-001
    b. Approved Equal
19. End Closing Kit, Cable Runway
    a. Chatsworth - Part Number 11700-712
    b. Approved Equal

H. Pathway Cable Support
1. Panduit J-Mod Cable Support System
    a. Erico – CADDY CAT LINKS J-Hook Series
    b. Approved Equal

I. Grounding and Bonding
1. Grounding Bus Bar, 20”
    a. Chatsworth - Part Number 40153-020
    b. Approved Equal
2. Grounding Bus Bar, 12”
    a. Chatsworth - Part Number 13622-012
    b. Approved Equal
3. Cable Runway Ground Strap Kit
    a. Chatsworth - Part Number 40164-001
    b. Approved Equal
4. One Mounting Hole Ground Terminal Block
    a. Chatsworth - Part Number 08009-001
    b. Approved Equal
5. Horizontal Rack Ground Bar for Wall Mount Cabinet
    a. Chatsworth - Part Number 10610-019
    b. Approved Equal
6. #6 AWG Solid Green Insulation Ground Wire
    a. Superior Essex - Part Number 12-018-04
    b. Approved Equal
7. #3/0 Stranded Green Insulation Ground Wire
8. Cable Sheath Bonding Clamp

J. Labeling
1. Permanent Labels for Fiber Optic Cables
    a. Brady
    b. Panduit Self Laminating Labels
2. Permanent Labels for Innerduct
    a. Panduit Dome-Top Ty Marker

3. Permanent Labels for Copper Cables
   a. Panduit Self-Laminating Labels
4. Permanent Labels for Backbone Fiber Optic Cables
   a. Panduit Dome-Top Ty Marker
5. Permanent Labels for Patch Panels
   a. Panduit Component Label
6. Permanent Labels for Faceplates
   a. Panduit Component Label

K. Fire Stop
1. STI Spec Seal
2. 3M Products

L. Plywood
1. 8’ H x 4’ W x ¾” Sheets of BC grade fire-rated plywood

M. Fire Retardant Paint (White)

N. Fiber Patch Cables
1. Leviton Fiber Optic patch Cords
2. Approved Equal

O. Copper Patch Cables
1. Leviton eXtreme Category 6+ SlimLine UTP Patch Cord –Part Number 6D460-xx*
2. Approved Equal

PART 3 EXECUTION

3.1 Codes, Standards, Regulations

A. American National Standards Institute (ANSI)

B. American Society for Testing and Materials (ASTM)
1. ASTM B 1 (2001; R 2007) Standard Specification for Hard-Drawn Copper Wire
2. ASTM B 8 (2004) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
3. ASTM D 1557 (2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
4. ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

C. Alliance for Telecommunications Industry Solutions (ATIS)

D. Building Industry Consulting Service International (BICSI)
1. Telecommunications Distribution Methods Manual 13th Edition
2. Outside Plant Design Reference Manual 5th Edition
3. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices

4. NECA/BICSI 568-2006 – Standard for Installing Commercial Building Telecommunications Cabling
5. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings

E. Electronics Industry Alliance (EIA)

F. Federal Communications Commission (FCC)
1. FCC Part 15, Radiated Emissions Limits, revised 1998
2. FCC Part 68, Connection of Terminal Equipment to the Telephone Network, revised 1998
3. FCC Part 76, Cable Television Service, revised 1998

G. Insulated Cable Engineers Association (ICEA)
1. ICEA S-87-640 (2006) Fiber Optic Outside Plant Communications Cable
2. ICEA S-98-688 (2006) Broadband Twisted Pair, Telecommunications Cable Aircore, Polyolefin Insulated Copper Conductors
3. ICEA S-99-689 (2006) Broadband Twisted Pair Telecommunications Cable Filled, Polyolefin Insulated Copper Conductors

H. International Electrotechnical Commission (IEC)

I. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
1. IEEE Standard 81-1983, IEEE Guide for Measuring Earth Resistance, Ground Impedance, and Earth Surface Potential of a Ground System
2. IEEE Standard 1100-1999, Recommended for practice for Powering and Grounding Sensitive
3. Electronic Equipment in Industrial and Commercial Power Systems (IEEE Emerald Book)
4. IEEE C2 (2007; Errata 2007; INT 2008) National Electrical Safety Code
5. IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

J. International Organization for Standardization (ISO)
1. International Organization of Standardization/International Electrotechnical Commission (ISO/IEC)
2. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
3. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999
4. ISO/IEC 11801, Information Technology-Generic Cabling for Customer Premises, 1995
5. ISO/IEC 14763-1, Information Technology-Implementation and Operation of Customer Premises Cabling-Administration, 1999

K. National Cable Television Association (NCTA)

L. National Electrical Manufacturers Association (NEMA)
1. NEMA C62.61 (1993) Gas Tube Surge Arresters on Wire Line Telephone Circuits

M. National Fire Protection Association (NFPA)
1. NFPA-70, National Electrical Code
2. NFPA-75, Protection of Electronic Computer Data Processing Equipment.
3. NFPA-101, Life Safety Code
4. NFPA-297, Guide on Principles and Practices for Telecommunications Systems
5. NFPA-780, Standard for the Installation of Lightning Protection Systems.

N. National Institute Standards and Technology (NIST)

O. Occupational Safety and Health Administration (OSHA)

P. Telecommunications Industry Association (TIA)
1. ANSI/TIA-568-C.0, Generic Telecommunications Cabling for Customer Premises, 2009
2. ANSI/TIA-568-C.1, Commercial Building Telecommunications Cabling Standard, 2009
3. ANSI/TIA -568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standard, 2009
4. ANSI/TIA-568-C.3, Optical Fiber Cabling Components Standard, 2008
5. ANSI/TIA/EIA–569-B, Commercial Building Standard for Telecommunications Pathways and Spaces, 2005
6. ANSI/TIA–569-B Amendment 1, Commercial Building Standard for Telecommunications Pathways and Spaces, 2009
7. ANSI/TIA/EIA-606-B, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings, 2012
8. ANSI/TIA/EIA-607-B, Commercial Building Grounding and Bonding Requirements for Telecommunications, 2011
9. ANSI/TIA-758, Customer-Owned Outside Plant Telecommunications Infrastructure Standard, 2004

Q. U.S. Department of Agriculture (USDA)
1. RUS 1755 Telecommunications Standards and Specifications for Materials, Equipment and Construction
2. RUS Bull 1751F-643 (2002) Underground Plant Design
3. RUS Bull 1751F-815 (1979) Electrical Protection of Outside Plant
4. RUS Bull 1753F-201 (1997) Acceptance Tests of Telecommunications Plant (PC-4)
5. RUS Bull 1753F-401 (1995) Splicing Copper and Fiber Optic Cables (PC-2)
6. RUS Bull 345-65 (1985) Shield Bonding Connectors (PE-65)
7. RUS Bull 345-72 (1985) Filled Splice Closures (PE-74)
8. RUS Bull 345-83 (1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)

R. Underwriters Laboratories, Inc. (UL)
1. UL 510 (2005; Rev thru Aug 2005) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
2. UL 910 (NFPA 262 1990) Applicable Flame Test

3.2 CODE CONFLICTS AND OMISSIONS

A. In the event of any conflicts between documents referenced herein and the contents of this specification, the Contractor shall notify the Architect/Engineer in writing of any such occurrences before purchasing or installing any equipment or materials. The Architect/Engineer will notify the Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event Contractor shall not supersede specifications and standards from the latest NFPA and NEC publications. In the event of any conflicts between Standards and Codes the more stringent shall take precedence.

3.3 GENERAL REQUIREMENTS

A. Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the aforementioned laws, ordinances, and rules, the matter shall be referred to the Architect/Engineer for direction before proceeding with that part of the work.

B. The Contractor shall be responsible for coordination with other trades to ensure any conflicts or potential conflicts are resolved prior to any work beginning on the project.

C. The Contractor shall install the materials in accordance with these specifications and the manufacturer’s installation guidelines.

D. No deviations from the plans or specifications shall be made without full consent in writing of the Architect/Engineer. The Contractor shall have written approval from the Architect/Engineer for any additional work beyond the Contract Documents prior to beginning such work. If the Contractor does not obtain written approval from the Architect/Engineer prior to proceeding with the work, the contractor shall not be reimbursed for the work.

E. The Contractor shall obtain written permission from the Architect/Engineer before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to girders, beams, floors, walls, roofs, or ceilings.

F. Contractor shall notify the Architect/Engineer a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the Architect/Engineer to perform a walkthrough, review the scope of work, schedule, and escalation procedures.

G. The Contractor shall maintain a work area free of debris, trash, empty cable reels, scrap cable, etc., and dispose of such items on a daily basis and return the site to the original state of cleanliness. The Contractor shall not use Owner’s facilities for the disposal of excess or scrap materials.

H. Equipment and materials installed by the Contractor shall be free of defects and damage.

I. Contractor shall be responsible for the repair of any damage caused by the contractor during the installation.

J. Contractor shall test all cables prior to installation. By failing to perform this testing operation, the Contractor shall accept the cable as compliant and assume all liability for the replacement of the cable at no cost to the Owner should it be found defective at a later date.

K. Contractor shall maintain a set of working specifications, design drawings, and record drawings to be kept on site at all times and shall update the record drawings with any changes on a weekly basis. Record drawings shall be made available for inspection at the request of the Architect/Engineer.

L. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.

M. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Contractor's expense.

N. Contractor shall make all stored equipment and materials available for inspection at the request of the Architect/Engineer.

O. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed.

P. Cables shall be properly supported in accordance with industry standards at all times. Improperly supported cables shall be corrected by the Contractor at no cost to the Owner.

Q. Contractor shall be responsible to properly protect information outlets from damage by other trades during construction.

R. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.

S. The Contractor shall not install cables in conduits or sleeves without nylon bushings. Cables installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.

3.4 SYSTEM REQUIREMENTS

A. Quantities listed are for reference only, contractor is responsible for furnishing materials as required to provide a complete and functioning system. Where quantities are not noted, they may be obtained from the drawings. In the event of a discrepancy between the specifications and the drawings, the greater quantity shall be furnished.

B. Inter-Building Cable Plant
   1. Fiber Optic Cable
      a. 9 µm Single Mode

1) Contractor shall furnish and install outdoor underground fiber optic cables in contractor-furnished and installed Max-Cell.
   a) Each fiber optic cable shall be provided with a dedicated innerduct.
2) The Contractor shall install a service loop at the ends of each cable to be coiled, mounted, and stored on the wall above the ladder rack. The service loop length should be the manufactures recommended length for service loops. If there is no manufactures recommend length, then the industry standard length should be used as per documented standards.
3) Cables shall be routed utilizing the pathways as indicated in the technology drawings.
4) The contractor shall furnish and install:
   a) 12 strand outdoor fiber optic cable from IT Room to any remote location exceeding lengths or as indicated on the technology drawings.

b. 50/125 µm Multi-mode
1) Contractor shall furnish and install outdoor underground fiber optic cables in contractor-furnished and installed innerduct.
   a) Each fiber optic cable shall be provided with a dedicated innerduct.
2) The Contractor shall install a service loop at the ends of each cable to be coiled, mounted, and stored on the wall above the ladder rack. The service loop length should be the manufactures recommended length for service loops. If there is no manufactures recommend length, then the industry standard length should be used as per documented standards.
3) Cables shall be routed utilizing the pathways as indicated in the technology drawings.

2. Fiber Optic Termination
a. Contractor shall terminate fiber optic strands with fan-out kits when required and connectors and place into fiber optic enclosures as indicated in the technology drawings.
b. Contractor shall furnish fiber optic enclosures and coupler panels for all fiber optic strands and blank panels for all unused slots.
c. The Contractor shall furnish and install:
1) 2U fiber enclosure(s) inside MDF rooms as indicated on the technology drawings.
2) 1U fiber enclosure(s) inside all IDF rooms as indicated on the technology drawings.

3. Copper Cable
a. High Pair Count Cable
1) Contractor shall furnish and install outdoor underground copper cables.
2) The Contractor shall install a service loop at the ends of each cable to be coiled, mounted, and stored on the wall above the ladder rack. The service loop length should be the manufactures recommended length for service loops. If there is no

manufactures recommend length, then the industry standard length should be used as per documented standards.

3) Cables shall be routed utilizing the pathways as indicated in the technology drawings.

b. High Pair Count Termination

1) Building Entrance Terminals

a) The contractor shall terminate all copper cable pairs on contractor furnished and installed building entrance terminals as indicated in the technology drawings.

b) Contractor shall furnish and install all terminals fully populated with surge protection modules.

c) Contractor shall ground and bond all cables and terminals.

2) Patch Panels

a) The Contractor shall furnish and install rack mounted voice patch panels.

b) The Contractor shall extend all copper cable pairs from the building entrance terminals to the rack mounted voice patch panels utilizing plenum rated high pair count cable.

c) The Contractor shall furnish and install enough patch panels to cover the number of data connections in the Building as indicated on the technology drawings.

c. Horizontal Cable

1) No horizontal cable shall be longer than two hundred ninety-five (295) feet. If any station cable will be longer than two hundred ninety-five (295) feet, Contractor shall stop installation of the cable and immediately notify Architect/Engineer in writing. If Contractor fails to notify the Architect/Engineer in writing, Contractor shall replace cable at no cost to the Owner.

2) The Contractor shall furnish and install horizontal cables within each Technology Region from the respective ER or TR to each outlet location as indicated in the technology drawings.

3) The Contractor shall install a service loop to be coiled, mounted, and stored above the ladder rack in each respective Equipment Room or Telecommunications Room. The service loop length should be the manufactures recommended length for service loops. If there is no manufactures recommend length, then the industry standard length should be used as per documented standards.

4) The Contractor shall provide a service loop coiled and supported directly above the workstation outlet. The service loop length should be the manufactures recommended length for service loops. If there is no manufactures recommend length, then the industry standard length should be used as per documented standards.

d. Horizontal Cable Termination

1) Contractor shall terminate cables as defined by the ANSI/TIA/EIA 568-A Commercial Building Wiring Standard with the EIA-568B sequence.
2) Workstations
   a) Contractor shall furnish and install modular jacks to terminate UTP horizontal cables.
   b) Contractor shall furnish and install faceplates, systems furniture faceplates, or surface-mount boxes to house modular jacks as indicated in the technology drawings.
      (1) Any unused faceplate positions shall have the appropriate number and color of blanks installed.
3) Equipment Rooms / Telecommunications Rooms
   a) Horizontal Cable for Data
      (1) Contractor shall furnish and install patch panels and horizontal cable managers to terminate horizontal data cables as indicated in the technology drawings. J
      (2) The Contractor shall furnish and install enough patch panels to cover the number of data connections in the Building as indicated on the technology drawings.
   b) Horizontal Cable for IP Security
      (1) Contractor shall furnish and install patch panels and horizontal cable managers to terminate horizontal IP security cables as indicated in the technology drawings. L
      (2) The Contractor shall furnish and install enough patch panels to cover the number of data connections in the Building as indicated on the technology drawings.

e. Patch Cables
1) Fiber
   a) Equipment Rooms / Telecommunications Room
      (1) The Contractor shall furnish and store (1) patch cable in original manufacturer packaging for each strand terminated per Equipment Room / Telecommunications Room.
         (a) 100% of the patch cables shall be (3) meters in length and stored in the applicable Equipment Room / Telecommunications Room
2) Copper
   a) Workstations
      (1) The Contractor shall furnish and store (1) patch cable in original manufacturer packaging for each cable terminated.
         (a) 100% of the patch cables shall be (10) feet in length and stored in the

applicable Equipment Room / Telecommunications Room.

b) Equipment Rooms / Telecommunications Rooms
   (1) The Contractor shall furnish and store (1) patch cable in original manufacturer packaging for each cable terminated per Equipment Room / Telecommunications Room.
      (a) 50% of the patch cables shall be (3) foot in length and stored in the applicable Equipment Room / Telecommunications Room
      (b) 35% of the patch cables shall be (7) foot in length and stored in the applicable Equipment Room / Telecommunications Room
      (c) 15% of the patch cables shall be (10) foot in length and stored in the applicable Equipment Room / Telecommunications Room

f. Cable Support
   1) All cables shall be installed and supported in conduit systems, cable trays, cores, sleeves, etc. as indicated in the technology drawings.
   2) When cables leave the main pathway systems as indicated on the technology drawings, they shall be installed and supported in Contractor furnished and installed j-hooks or adjustable cable supports.
   3) No cable pathway shall exceed 40% fill ratio.
   4) The contractor shall furnish a separate j-hook or adjustable cable support pathway for each cable type (data, voice, video, and security).
   5) J-hooks and adjustable cable supports shall be installed no more than five-feet (5') apart on center, using only manufacturer-approved installation methods and hardware.
   6) J-hooks and adjustable cable supports shall be installed no higher than 3-feet above the accessible ceiling to allow for ease of access for future moves, adds and changes
   7) If utilizing ceiling grid wire, that is contractor installed, both ends shall be supported and independent from the grid wire to provide support for the actual grid and ceiling tile. Grid wire shall be painted blue and attached to ceiling grid with a Caddy Component Support.
   8) J-hooks shall be furnished with closure clips.
   9) Maximum sag between supports shall not exceed twelve-inches (12").
   10) Contractor shall establish j-hook and adjustable cable supports pathways and shall coordinate pathways with all other disciplines. Under no-circumstances shall these pathways be

used to support other low-voltage applications not included in this specification.

11) Cable Dressing
    a) No nylon cable ties shall be used at any time during the installation of the cable.
    b) Above Ceiling
        (1) Contractor shall furnish and install plenum-rated hook & loop straps in plenum-rated airspaces.
            (a) The Contractor shall install no more than (1) hook & loop strap between each j-hook or saddle strap or at service loop locations.
    c) Equipment Rooms / Telecommunications Rooms
        (1) The Contractor shall bundle all visible cables with Contractor furnished and installed hook & loop straps.
            (a) Hook & loop straps shall be installed twenty-four (24) inches apart on center.

g. Equipment Rooms / Telecommunications Room Build-Out
    a) Plywood
        (1) The Contractor shall furnish and install two 8’ H x 4’ W x ¾” D sheets of BC grade fire-rated plywood per MDF / IDF as indicated in the technology drawings.
        (2) The Contractor shall mount all plywood vertically starting at 24” Above the Finished Floor (AFF).
        (3) The Contractor shall cover the plywood with two (2) coats of Contractor furnished white fire retardant paint leaving exposed (1) fire rating stamp per sheet.
    b) Cable Runway (Ladder Type)
        (1) Contractor shall furnish and install cable runway using manufacturer-approved hardware and installation methods as indicated in the technology drawings.
        (2) Contractor shall furnish and install vertical sections of cable runway using manufacturer-approved hardware and installation methods to provide transition and support where cables enter or exit the room using a vertical pathway.
        (3) Contractor shall furnish and install radius drops cross member and stringers above each rack using manufacturer-approved hardware and installation methods where cables exit the horizontal section of the ladder rack.
        (4) Contractor shall ground and bond each cable runway section to the next utilizing ground straps and ensure metal-to-metal contact.

c) Equipment Racks and Cabinets
(1) Contractor shall furnish and install equipment racks with vertical management using manufacturer approved hardware and installation methods as indicated in the technology drawings.
(2) Contractor shall secure relay racks to the concrete floor utilizing expandable concrete anchors.
(3) Contractor shall secure the equipment racks to the cable runway using cable runway elevation kits and manufacturer approved hardware and installation methods.
(4) Contractor shall bolt all equipment racks and vertical cable managers together.
(5) Contractor shall individually ground and bond each equipment rack and ensure metal-to-metal contact.
(6) Contractor shall furnish and install:
(a) 19” x 84" equipment rack(s) in MDF & IDF rooms as indicated on the technology drawings
(b) Wall mounted equipment rack(s) as indicated on the technology drawings

h. Grounding and Bonding
1) General
a) The Contractor shall ensure metal-to-metal contact for all terminations.
b) All materials shall be UL Listed.
c) All connections shall be made with UL Listed compression 2-hole lugs.
d) Contractor shall use an anti-oxidation compound on all connections.
e) In a metal frame (structural steel) building, where the steel framework is readily accessible within or external to the room; each TMGB and TGB shall be bonded to the vertical steel metal frame using a minimum # 6 AWG plenum rated green insulated conductor.
f) A Grounding Equalizer conductor shall be installed when required by ANSI/TIA/EIA-607-B (Interconnects multiple TBBs on the top floor and every 3rd floor in between).
g) The connection to building steel does not eliminate the requirement for the TBB or EBC to the service ground.
2) Telecommunications Main Grounding Busbar (TMGB)
a) Contractor shall furnish and install a TMGB in the Equipment Room/Main Telecommunication Room as indicated in the technology drawings.

b) TMGB shall be insulated from its support using an insulator that is listed for the purpose by a nationally recognized testing laboratory (NRTL).
c) Only one lug shall occupy a hole. No stacking lugs or "Double Lugging" shall be accepted.

3) Telecommunications Grounding Busbar (TGB)
a) Contractor shall furnish and install a TGB in each Telecommunications Room as indicated in the technology drawings.
b) TGB shall be insulated from its support using an insulator that is listed for the purpose by a nationally recognized testing laboratory (NRTL).
c) Only one lug shall occupy a hole. No stacking lugs or "Double Lugging" shall be accepted.

4) Telecommunications Bonding Backbone (TBB)
a) The Contractor shall furnish and install a TBB consisting of a minimum #6 AWG plenum rated green insulated copper conductor in a star topology between the TMGB and each TGB as indicated in the Technology drawings.
b) When exceeding (13), feet the TBB shall be sized at (2) kcmil per linear foot of conductor length up to a maximum of 750 kcmil.
c) Where the TRs are stacked the TBB shall be continuous to the uppermost TR. "T" taps shall be used to tie TGBs on floors between the TMGB and the uppermost TGB.
d) Conductor shall be sized from the TMGB to the uppermost TGB and each conductor between a "T" tap and the TGB shall be the same size as the TBB it is fed from.

5) Equipment Bonding Conductor (EBC)
a) Contractor shall furnish and install a minimum #6 AWG plenum rated green insulated conductor from the TMGB or TGB as applicable to each ladder rack system, equipment rack, cabinet, metallic raceway, lightning protector, or multi-pair cable with a metallic element. Contractor shall use an anti-oxidation compound on all connections.
b) When exceeding (13) feet the EBC shall be sized at (2) kcmil per linear foot of conductor length up to a maximum of 750 kcmil.

6) Bonding Conductor for Telecommunications (BCT)
a) Contractor shall furnish and install a minimum #6 AWG plenum rated green insulated copper conductor from the TMGB to the main building electrical service ground as indicated in the Technology drawings.
b) The installation of the BCT to the main building electrical ground shall be performed by a licensed Electrical Contractor.

c) When exceeding (13) feet the BCT shall be sized at (2) kcmil per linear foot of conductor length up to a maximum of 750 kcmil

i. System Labeling

1) Contractor shall verify room numbers and confirm the final room numbering scheme prior to generating any labels.
2) Horizontal Cables shall be labeled within (12) inches from the termination point inside the Equipment Room/Telecommunications Rooms.
3) Horizontal Cables shall be labeled within (6) inches from the termination point at the workstation end.
4) Backbone Fiber and Copper Cables shall be labeled within (12) inches of the visible end of the jacket.
5) Fiber Innerduct shall be labeled within (12) inches of the point of entry of the fiber optic enclosure.
6) Bonding conductors shall be labeled within (12) inches from their termination point.
7) Cables shall be labeled identically at both ends.
8) Equipment Racks
   a) Equipment racks in each Equipment/Telecommunication Room shall be labeled in sequential numeric order.
      (1) Labels shall be centered on the top front of the equipment rack.
9) Cabinets
   a) Cabinets in each Equipment/Telecommunication Room shall be labeled in sequential numeric order.
      (1) Labels shall be centered on the top front of the Cabinet.
10) Fiber Optic Enclosures
   a) Fiber optic enclosures shall be labeled alpha-numeric starting with the 1st fiber optic enclosure in the top of the 1st equipment rack.
   b) A label for each terminated strand shall be securely placed inside each fiber optic enclosure.
11) Backbone Cable
   a) Fiber Optic Cable
      (1) Fiber optic backbone cable labels shall contain the cable origin room number, the cable destination room number, fiber strand numbers, and type (i.e. B126-A118/001-012MM).
      (2) Fiber optic couplers panels in fiber enclosures shall be labeled at each end by strand denoting building code, Equipment Room and/or Telecommunications Room, enclosure number, and strand number to and from respectively (i.e. B126/01/01-12 – A118/01/01-12).
   b) High Pair Count Copper Cable
      (1) For high pair count copper backbone cables, the label scheme shall contain, cable origin room

number, the cable destination room number, and cable pairs (i.e. B126-A118/001-025).

12) Horizontal Cable a. Inside Equipment Rooms
    a) Horizontal cables shall be labeled at each end with the destination end and origin room number, patch panel number, and port number. (i.e. B126-B127-A01).
    b) Patch panels in each closet shall be labeled sequentially starting with the first Patch Panel in the top of the first relay rack (A, B, C, D, E, etc.).
    c) 110-type blocks shall contain the destination room number, pair numbers, and binder pair number under each pair termination. (example) a) 110-type block labels shall be printed on product-specific label strips and placed into label holders.
13) Workstation Faceplates
    a) Cables and wall plates shall be labeled denoting origin, Equipment Room/Telecommunications Room Number, Patch Panel, 110-type termination block, and Port Number. (i.e. B127-A01).
14) TMGB and TGB
    a) TMGB and TGB shall be labeled with a unique identifier (i.e. TMGB-B126, TGB-A118).
15) Bonding Conductors
    a) The following conductors shall be labeled at each end with the destination end and origin room number (i.e. B126 – IDFA118).
        (1) Bonding Conductor for Telecommunications
        (2) Telecommunications Bonding Backbone
        (3) Grounding Equalizer

3.5 TESTING REQUIREMENTS

A. Fiber Optic Cable
1. Installed strands shall be tested and certified in accordance with industry standards.
2. Only Manufacturer Certified Technicians shall perform testing.
3. The Contractor shall test and certify all fiber optic cable strands with approved field tester(s) that are within their calibration period. The Contractor shall be liable for all re-testing required in the event tests are performed with non-approved test equipment or tester(s) that are not within their calibration period.
4. The Contractor shall provide calibration results from the manufacturer showing the current calibration of the testers.
5. The Contractor shall notify the Architect/Engineer a minimum of five (5) days in advance to observe cable testing.
6. The Architect/Engineer may randomly select 5% of the installed strands for test verification purposes. The Contractor shall re-test these strands in the presence of the Architect/Engineer and the results shall be compared to the previously Contractor submitted test results. In the event that any of the verification tests differ in results from the previously submitted test results, all testing shall be

declared a failure and the Contractor shall re-test 100% of the installed strands at no cost to the Owner.

B. Copper Backbone Cable
1. Installed pairs shall be tested and certified in accordance with industry standards.
2. Only Manufacturer Certified Technicians shall perform testing.
3. The Contractor shall test and certify all copper pairs with approved field tester(s) that are within their calibration period. The Contractor shall be liable for all re-testing required in the event tests are performed with non-approved test equipment or tester(s) that are not within their calibration period.
4. The Contractor shall provide calibration results from the manufacturer showing the current calibration of the testers.
5. The Contractor shall notify the Architect/Engineer a minimum of five (5) days in advance to observe cable testing.
6. The Architect/Engineer may randomly select 5% of the installed pairs for test verification purposes. The Contractor shall re-test these pairs in the presence of the Architect/Engineer and the results shall be compared to the previously Contractor submitted test results. In the event that any of the verification tests differ in results from the previously submitted test results, all testing shall be declared a failure and the Contractor shall re-test 100% of the installed pairs at no cost to the Owner.

C. Category 6 UTP Cable
1. Cable links shall be tested and certified in accordance with industry standards.
2. Only Manufacturer Certified Technicians shall perform testing.
3. The Contractor shall test and certify the structured cable system with approved field tester(s) that are within their calibration period. The Contractor shall be liable for all re-testing required in the event tests are performed with non-approved test equipment or tester(s) that are not within their calibration period.
4. No Fail or *Pass results will be accepted.
5. The Contractor shall notify the Architect/Engineer a minimum of five (5) days in advance to observe field testing.
6. The Architect/Engineer may randomly select 5% of the installed links for test verification purposes. The Contractor shall re-test these links in the presence of the Architect/Engineer and the results shall be compared to the previously Contractor submitted test results. In the event that any of the verification tests differ in results from the previously-submitted test results, all testing shall be declared a failure and the Contractor shall re-test 100% of the installed links at no cost to the Owner.

D. Grounding and Bonding
1. Main Building Ground
   a. Coordinate with electrical contractor and provide a copy of their test results for the main building ground. The results shall be below 25 Ohms.
2. Two-Point Ground/Continuity Testing
   a. Prior to the two-point ground testing, a visual inspection shall be performed to verify that the bonding and grounding system is installed

according to the drawings and specifications and in compliance with the TIA-607-B Standard.

b. All testing shall be conducted prior to any active equipment is installed.

c. The Contractor shall use an earth ground resistance tester that is configured for a continuity test. This is also known as a two-point tester or a “dead earth” test.

d. Prior to the two-point continuity test

e. The testing shall include but is not limited to the following points.

1) Building electrical grounding electrode and the TMGB.
2) TMGB/TGB to electrical ground in ER/TR.
3) TMGB/TGB to the building steel (if present).
4) TMGB to each TGB.
5) Building steel (if present) to the electrical ground.

E. Per the TIA-607-B, the maximum value for resistance between any point in the telecommunications bonding and grounding system and the building’s electrical grounding electrode system is 100 milliohms. In the case of long TBB and Grounding Equalizer conductor runs, the resistance of the conductor must be factored into the total resistance. For example 1 km of a No. 3/0 conductor has a resistance of 0.2028 ohms. (0.06180 ohms per 1000 ft.)

F. The Contractor shall notify the Architect/Engineer a minimum of five (5) days in advance to observe field testing.

3.6 PROJECT CLOSE OUT DOCUMENTATION

A. A. As-Built Drawings

1. Drawings shall be provided to the Architect/Engineer at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the Architect/Engineer.
2. Three (3) sets of drawings depicting the condition of the structured cabling system as installed.
3. As-Built drawings shall be produced in AutoCAD 2014 or higher and provided in hardcopy and electronically in .dwg and PDF format.
4. Hardcopy drawings shall be provided in the original size as issued by the Architect/Engineer.
5. Drawings shall retain the formatting and title block of the original drawings as issued by the Architect/Engineer.
6. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of all equipment room/telecommunication room layouts, wall elevations, equipment rack elevations, ladder racks, cable tray, sleeves, backbone and horizontal cable pathways, workstation locations, and labeling scheme.

B. Test Documentation

1. Test documentation shall be provided to the Architect/Engineer at the time of substantial completion. Final payment will not be recommended until these test results are received and approved by the Architect/Engineer.
2. Three (3) sets of test documentation for the structured cabling system as installed

3. Test results shall be provided in hard copy and electronic format (i.e., manufacturer's proprietary testing software along with applicable reader software) and PDF electronic format.
4. Test documentation shall be bound, sectioned, and tabbed in the following sequence as applicable:
    a. Tester(s) Calibration Certificate(s)
    b. Inter-Building Backbone Fiber Optic Cable
    c. Inter-Building Backbone Copper Cable
    d. Intra-Building Backbone Fiber Optic Cable
    e. Intra-Building Backbone Count Copper
    f. Horizontal Category 3 Cable
    g. Horizontal Category 6 Cable
    h. Main Building Ground
    i. Two-Point Ground/Continuity Test

C. Manufacturer's Performance Certification
1. Certificate shall be provided to the Architect/Engineer at the time of final system acceptance. Final payment will not be recommended until the certificate of certification is received and approved by the Architect/Engineer.
    a. The manufacturer of the solution shall furnish a performance certification for a period of no less than twenty (20) years starting at final system acceptance.
    b. One original and two copies of the Manufacturer's Certificate shall be provided.

D. Manufacturer's Product Warranty
1. Certificate of product warranty shall be provided to the Architect/Engineer at the time of final system acceptance. Final payment will not be recommended until this certificate of product warranty is received and approved by the Architect/Engineer.
    a. The manufacturer of the solution shall furnish an extended warranty for a period of no less than twenty (20) years starting at final system acceptance.
    b. One original and two copies of the Manufacturer's product warranty shall be provided.

E. Contactor's Statement of Warranty
1. Statement of warranty shall be provided to the Architect/Engineer at the time of substantial completion. Final payment will not be recommended until statement of warranty is received and approved by the Architect/Engineer.
    a. Contractor shall furnish a minimum of a one (1) year warranty on all materials, labor and workmanship starting at final system acceptance.
    b. One original and two copies of Contractor's warranty terms and conditions to include contact information (i.e. Contractor name, Point of Contact, address, phone number and email address) and start and end date for warranty call outs.

END OF SECTION

SECTION 28 13 00

SECURITY SYSTEM

PART 1 - GENERAL

1.1 GENERAL

A. This section identifies the requirements, technical design, and specifications for the security system at the Texas Department of Transportation (TxDOT) Building as indicated on the drawings.

B. The access control system as specified must be compatible and interoperable with TxDOT's latest version Software House C●CURE as a standard. This includes card readers, electrified locksets, door position sensors, gate release, control panels, glass breaks, intercoms, and access control cabling.

C. The intrusion detection and notification devices as specified must be compatible and interoperable with TxDOT's latest version Software House C●CURE as a standard. This includes glass breaks, all position switches, duress/panic buttons cabling, etc., installation and programming to the C●CURE system

D. The electronic surveillance system as specified is an industry standard and includes camera, encoders, decoders, monitor, video splitter, video transceiver, video receiver and cabling.

E. The Contractor shall provide a Manufacturer's Performance Certification for the installed access control system.

F. Contractor shall include materials, equipment, programming and labor necessary to provide a complete and functional access control system regardless of any items not listed or described in this specification or associated drawings.

1.2 DEFINITIONS

A. ACS – Access Control System
B. DGP – Data Gathering Panels
C. DC – Door Contact
D. OHD – Overhead Door
E. HID – Hughes Identification devices
F. IP – Internet Protocol
G. OEM – Original Equipment Manufacturer
H. T xDOT _ Texas Department of Transportation
I. PM – TxDOT Project Manager
J. SW H – Software House
K. VAC – Volts Alternating Current
L. VDC – Volts Direct Current
M. LAN – Local Area Network

N. LED – Light-emitting Diode
O. AFG – Above Finished Grade
P. AD – American Dynamics
Q. VMS – Video Management System
R. ESS – Electronic Surveillance System
S. NVR – Network Video Recorder
T. NIC – Network Interface Card

1.3 REQUIREMENTS

A. Contractor Experience Requirements

B. Submittal Requirements

C. Acceptable Manufacturers

D. Codes, Standards and Regulations

E. General Requirements

F. System Requirements

G. Testing Requirements

H. Training Requirements

I. Project Closeout Documentation

J. Attachments

1.4 RELATED REQUIREMENTS

A. The Drawings, Specifications, General Conditions, Supplementary General Conditions, and other requirements of Division 1 apply to the work specified in Division 28, and shall be complied with in every respect. The Contractor shall examine all of the items which make up the Contract Documents and shall coordinate them with the work on the project.

B. Respondent qualifications: The respondent shall:
   1. Be a company engaged in the business of providing, installing, and maintaining SWH C●CURE® card access systems for a minimum of three years within the last five years. Recent start-up businesses do not meet the requirements of this solicitation. A startup business is defined as a new company that has no previous operational history or expertise in the relevant business and is not affiliated with a company that has that history or expertise.
   2. Be an authorized dealer or distributor of SWH C●CURE® card access systems.

3. Be in good financial standing, current in payment of all taxes and fees such as state franchise fees. TxDOT reserves the right to request a copy of the respondent's audited or un-audited financial statement.
4. When financial statements are requested, TxDOT will review the respondent's audited or un-audited financial statement to this solicitation in accordance with Texas Government Code, T itle 10, Subtitle D, §2156.007 to evaluate the sufficiency of the respondent's financial resources and ability to perform the contract or provide the service required in the solicitation. T xDOT will be the sole judge in determining the sufficiency of the respondent's financial resources and ability to perform the contract or provide the service. Factors to be reviewed include:
    a. Balance sheets.
    b. Net working capital.
    c. Current asset ratio.
    d. Liquidity ratio.
    e. Auditor(s) notes.
    f. Any notes to the financial statements.

C. References: The respondent should submit a minimum of three references to substantiate the qualifications and experience requirements for similar services completed within the past 60 months. References shall illustrate respondent's ability to provide the services outlined in the specification. References shall include name, point of contact, telephone number, and dates services were performed. T he response will be disqualified if T xDOT is unable to verify qualification and experience requirements from the respondent's references. The response may be disqualified if T xDOT receives negative responses. TxDOT will be the sole judge of references.

D. Key personnel qualifications: The respondent shall provide the following key personnel:
1. Project Manager: The respondent shall designate a Project Manager who shall:
    a. Have a minimum of three years' experience within the last five years in project management for the installation and maintenance of SW H C●CURE® card access systems.

E. Key personnel qualifications: The respondent shall provide the following key personnel:
1. PM: The respondent shall designate a PM. The PM shall:
    a. Have a minimum of three years' experience within the last five years in project management for the installation and maintenance of SWH C●CURE® card access systems.
    b. Have successfully completed SWH certification course AC4005: C●CURE® 800/8000 Advanced Integrator and be certified by SWH as an Advanced Integrator.

2. Service Technicians:
    a. Shall have a minimum of three years' experience within the last five years, installing and maintaining SWH C●CURE® card access systems.
        1) AC4004-1: C●CURE® 800/8000 System Installer/Maintainer with iST AR™
            a) OR
        2) AC4004: C●CURE® 800/8000 System Installer/Maintainer and AC2414: iST AR™

b. A minimum of one Service Technician shall have successfully completed the following SW H certification course(s) and be certified by SW H as an Installer/Maintainer (Level 2):
   1) AC4004-1: C●CURE® 800/8000 System Installer/Maintainer with iSTAR™
      a) OR
   2) AC4004: C●CURE® 800/8000 System Installer/Maintainer and AC2414: iSTAR™

F. Vendor Requirements: The vendor shall:
1. Adhere to the TxDOT Terms and Conditions
2. Contractor shall conduct a full functionality test of any and all existing C●CURE systems and associated hardware. Submit complete test report to TXDOT before any work is to begin. Testing shall be coordinated with TXDOT Security
3. All deficiencies shall be documented and provided to TxDOT. Contractor will provide an additional quote for repairs. Contractor shall not fix any deficiencies without TxDOT approval
4. Provide a certified install technician on-site at all times while work is being performed on C●CURE® hardware
5. Provide the complete turnkey installation and programming of SW H C●CURE® card access system(s) and AD Cameras System.
6. Revise existing SW H C●CURE® card access system programming to reflect current system programming standards available at the time of installation.
7. Furnish all personnel, labor, tools, test equipment, replacement parts, programming, and transportation required to install the SW H C●CURE® card access system(s) described in this solicitation.
8. Provide and install all system components, including all attachments and ancillary items required to make the system fully operational including, but not limited to, all EMT conduits and wiring for card readers, intercoms, and fixed ESS cameras. Conduits, wire mold, wiring, cabling and all associated equipment shall be:
   a. Rated for installation location and device.
   b. Concealed within walls, ceilings, doorframes, or placed within existing conduit. If wire cannot be concealed in this manner, finished wire mold may be used on the inside of buildings and EMT conduit may be used on the outside. All wire mold and exposed conduits shall be approved by TxDOT Project Manager "PM".
9. Provide all equipment necessary to facilitate communications, (i.e.: terminal servers, short haul modems, and fiber optic transmission devices, etc.). All communications shall be fully supervised.
10. Provide programming configuration spreadsheets to the TxDOT Security System Specialist for approval prior to programming.
11. Complete all system programming of all TxDOT facilities associated to this solicitation. All programming shall follow the naming convention(s) outlined by TxDOT Statewide Security C●CURE Configuration and Programming guide with the following exception:
   a. Exception: Any programming conventions or other software options, or both, which allow TxDOT Security to define security controls, directly or indirectly, shall be coordinated with and approved by TxDOT Security System Specialist
   b. Note: For detailed instructions/guidelines on programing and configuration refer to the TxDOT document "C●CURE® Configuration and Programing Guide". Request latest version from TxDOT Security System Specialist.

G. Key Personnel Requirements: The PM shall:
1. Be on site during all phases of the project: Preparation, installation, and activation; until the SWH C●CURE® card access system is complete and accepted by TxDOT.
2. Be available by phone 24 hours a day/7 days a week and shall respond to TxDOT within 30 minutes of TxDOT's call.
3. Have the primary responsibility of the day-to-day operation, ensuring proper installation of the SWH C●CURE® card access system in accordance with the requirements of the purchase order; and coordination of all activities, situations, and issues with subcontractors and TxDOT.
4. Be a permanent staff employee.

H. Service Requirements: The vendor shall:
1. Cover and protect the furnishings and floor area for installations located above the ceiling line and above a work area prior to commencing work.
2. Clean all areas of scrap materials, dirt, dust, and debris generated in performance of the installation at the end of each working day to the satisfaction of PM or onsite personal.
3. Clean, repair, or replace any item damaged by the vendor or its subcontractor(s) during the installation to the satisfaction of PM or onsite personnel, and at no additional cost to TxDOT.
4. Replace any ceiling tile that was damaged during installation. Match existing.
5. Remove and dispose of all defective materials removed from the building during the installation in accordance with all applicable rules, regulations, codes, laws, ordinances, and statutes, etc. The vendor shall obtain TxDOT approval for removal or disposal, or both, of all mechanical and electrical parts.
    a. NOTE: All mechanical and electrical parts removed from the building shall remain the property of TxDOT.

I. Submittal
1. List of all equipment and materials included in bid and required for the installation of the access control system as specified herein. This list shall be provided in electronic format and contain: Part Number, Description, and Unit of Measure, to provide a complete and functional access control system.
2. Estimated cable count required for the access control system listed per Equipment Room and or Telecommunications Room. This list shall be provided in electronic format (Microsoft Excel).
3. Manufacturer Product Certifications for Company.
4. Manufacturer Product Certifications for Installers.
5. Manufacturer Warranty offering.
6. Documentation indicating Contractor has been in business for (5) years installing Software House C●CURE security systems.
7. Address of Contractor's closest office to site.
8. Quantity of full-time local technicians within a 75-mile radius of the project site.
9. List of five (5) contractor-installed projects of a similar size and scope in operation for at least (1) year. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
10. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start

Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.

J. Pre-Installation Submittal
1. Contractor shall not order, purchase, or install any equipment until pre-installation submittals have been accepted in writing by the Architect/Engineer.
2. Manufacturer product data sheets for each proposed system component.
   a. For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or Product being submitted Equipment schedules listing all system components, the manufacturer, model number and quantity of each.
3. Shop drawings of the proposed system installation.
   a. Shop drawings shall include card reader locations, door position sensor locations, access control panel elevations to include layout and power supply locations, installation typical details, preliminary cable numbers, proposed cable pathways, system schematics, and riser diagrams. Shop drawings shall be submitted on 30" X 42" bond paper.
   b. Contractor shall maintain a set of shop drawings on site at all times and shall update the shop drawings on a weekly basis. Shop drawings shall be made available for inspection at the request of the Architect/Engineer.
4. Manufacturer Product Certifications for Company.
5. Manufacturer Product Certifications for Installers.
6. Manufacturer Warranty letter.
7. Documentation indicating that Contractor has been in business for (5) years.
8. Address of Contractor's local office within a 75-mile radius of the project site.
9. Quantity of full time local technicians within a 75-mile radius of the project site.
10. List of five (5) contractor-installed projects of a similar size and scope in operation for at least (1) year. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, Brief Description of Project, Client Point of Contact Name and Phone Number.
11. List of completed and ongoing projects with the Owner. The Contractor shall provide the following information for each project: Project Name, Project Location, Project Start Date, Project Completion Date, Project Start Cost, Project Completion Cost, and Brief Description of Project.

K. Pre-Installation Submittal
1. Contractor shall not order, purchase, or install any equipment until pre-installation submittals have been accepted in writing by the TxDOT Project Manager.
2. Manufacturer product data sheets for each proposed system component.
   a. For product data sheets containing more than one (1) part number or product, the Contractor shall clearly identify the specific part number or product being submitted and equipment schedules listing all system components, the manufacturer, model number and quantity of each.
3. Shop drawings of the proposed system installation.
   a. Shop drawings shall include card reader locations, door position sensor locations, access control panel elevations to include layout and power supply locations, installation typical details, preliminary cable numbers, proposed cable pathways,

system schematics, and riser diagrams. Shop drawings shall be submitted electronically.

b. Contractor shall maintain a set of shop drawings on site at all times and shall update the shop drawings on a weekly basis. Shop drawings shall be made available for inspection at the request of the TxDOT Project Manager.

4. Manufacturer Product Certifications for Company.
5. Manufacturer Product Certifications for Installers.
6. Manufacturer Warranty letter.
7. Documentation indicating that Contractor has been in business for (5) years.
8. Quantity of full time technicians available to service site and their locations.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. The following sections specifically list the acceptable equipment types and items for this project.

B. PM will have final determination of acceptability of all proposed equipment and must approve submitted equipment prior to purchase or installation.

C. Proposed equivalent items must be approved in writing by the PM prior to submitting a bid. Proposed equivalent items must meet or exceed these specifications and the specifications of the specified item.

D. In the event a manufacturer's specified product or part number has changed or is no longer available, Contractor shall substitute the appropriate equivalent manufacturer's part number.

E. In the event of a discrepancy between the specifications and the drawings, the greater quantity and/or better quality will be furnished.

F. For listed products with no part number specified, Contractor shall provide a product that meets the performance requirements of these specifications, industry standard practices, and intended application.

G. All wiring, equipment, and installation materials shall be new and of the highest quality.

H. Labels on all wiring, materials, and equipment must indicate a nationally recognized testing laboratory.

I. Original Equipment Manufacturer (OEM) documentation must be provided to the PM which certifies performance characteristics and compliance with industry standards and TxDOT standardized security system.

2.2 ACCEPTABLE MANUFACTURERS

A. Access Control System Software/Hardware

1. Access Control Software

a. SW H C●CURE®
2. Access Control Panels
a. C●CURE® iST AR Ultra SE
b. C●CURE® iSTAR Edge
3. Life Safety Power
a. Life Safety Power FPO150/250-2D82M8NL4E8S/T16-B (36H x 30W x 4.5D cabinet) prewired with network board and battery, 120vac
4. Card Reader
a. Multi-Technology
1) Wall Mount
a) HID® 40NKS-00-000000 Multi-class Signo reader
b. Mullion Mount
a) HID® 20NKS-00-000000 Multi-class Signo reader
c. Long Range Reader (Gate Readers)
1) HID® MaxiProx 5375, 125 kHz

B. Surge Protection
1. Exterior Card Readers Mounted on Vehicle and Pedestrian Gates
a. DITEK_DTK-4LVPCR
b. Or TxDOT approved equal
2. Exterior Intercoms and IP Cameras on Vehicle Gates, Pedestrian Gates
a. DTK-WM4NETS
b. Or TxDOT approved equal
3. Exterior Intercoms and IP Cameras from Vehicle Gates at point of entry into building
a. DTK-WM8NETS
b. Or TxDOT approved equal
4. Gate Operators
a. DITEK-DTK-120/240 HD2
b. Or TxDOT approved equal
5. Exterior Intercoms and IP Cameras
a. DTK-WM4NETS
b. Or TxDOT approved equal

C. Vehicle gate pedestal and pedestal base
1. Provided by Owner (TxDOT). Refer to drawings details and location.
2. Furnish and install dedicated power supply for pedestal card readers.
3. Furnish and install KNOX Box Model 3502 Key switch, coordinate Keying with local AHJ.

D. Electrified Locking Mechanisms
1. Furnish and install electrified locking hardware as indicated on the drawings

E. Electrified Locking Mechanism Power Supply
1. Von Duprin Model # PS914 for EL panic bars
2. Or TxDOT approved equal

F. Request-to-Exit (REX) Device
1. REX Infrared Motion Sensor
a. BOSCH DS160

b. Or TxDOT approved equal

G. ADA Automatic Door Lock Interface
1. BEA – BR3-X
2. Or TxDOT equal

H. Duress/Panic Button
1. Honeywell 269R
2. Or TxDOT approved equal

I. Door/Gate Release Button
1. HUB3B Momentary
2. OR T xDOT approved equal

J. Video Display Monitor
1. American Dynamics Model ADLCD24MPB (24" LCD monitor)
2. Or TxDOT approved equal

K. Video Display Monitor Mount
1. American Dynamics ADWA1TR75100B)
2. Or TxDOT approved equal

L. Gate Reader dedicated power supply
1. LifeSafety – FPO75-D8PE1
2. Or TxDOT approved equal

M. Gate Release
1. HUB3B Momentary
2. Or approved equal

N. Gate/Door Intercom
1. Viking Model E-30-IPEWP (if within distance limits) or Viking Model E-30-EWP with T XDOT approval
2. Viking VKW E5X5 back box for each Intercom
3. Viking Model # RC-4A or C 2000 with TXDOT PM approval
4. Viking Model # E-35-IP/EWP (Door Only)

O. Gate Camera
1. IP: Illustra Model # IPSO2D2OSWIT
2. Or TxDOT approved equal

P. Gate Camera power supply
1. AXIS T 8123_E
2. Or TxDOT approved equal

Q. Video IP Decoder
1. Costar CVI2MV2
2. Wisenet SPD-150 48CH Network Video Decoder
3. Or TxDOT approved equal

R. Outdoor Rated Midspan POE
   1. Veracity VOR OUTREACH MAX universal Ethernet and POE extender
   2. or TXDOT approved equal

S. Glass Break Sensor
   1. Ceiling Mount
      a. Honeywell FG730
      b. Or approved equal
   2. Restrooms only
      a. Bosch ISC-SK10 Shock Sensor

T. Interior Speaker
   1. American Dynamics Model ADLCD24MPB (24" LCD monitor)
   2. Or TxDOT approved equal

U. Pre-Recorded Sounder
   1. Elk Products, ELK-124
   2. Or approved equal.

V. Exterior Weather Proof Strobe
   1. Amseco, SL401 strobe light lens color blue
   2. Or approved equal

W. Device Power Supplies (Glass Break Sensors, Pre-Recorded Sounders and Exterior Strobes)
   1. LifeSafety FP075-D8PE2
   2. LifeSafety Power FP075-2D8PE2
   3. Or TxDOT approved equal

X. Door/Vehicle Gate/Pedestrian Gate/ Roof Hatch Position Switches
   1. Concealed Door/ Pedestrian Gate/ Roof Door Position Switch
      a. Sentrol model 1078C
   2. Surface Mount Door/ Pedestrian Gate/ Roof Door/Hatch Position Switch
      a. 2507ADsurface mount (only with prior approval from PM)
      b. GRI-29A surface mount (only with prior approval from PM)
   3. Overhead Door Position Switch
      a. Sentrol 2300 series overhead door contact rail mount
      b. Sentrol 2200 series overhead door contact surface mount (only with prior approval from TxDOT PM)
      c. Or TxDOT approved equal

Y. Access Control System Cabling
   1. Multi-Conductor Shielded Plenum rated Composite Cable
      a. West Penn
         1) AC251822 Plenum Access Control Composite cable
      b. Belden
         1) 658GMS Composite – Lock, Card Reader, Door Contact, Rex Applications
      c. LAKE CABLE LLC
         1) S80081709-04 Plenum Rated Data Communications Composite Cable
         2) Or Approved Equal

2. Glass Breaks System Cabling
    a. West Penn
        1) 253241B- 22/4 Stranded overall aluminum shield plenum
    b. W indy City Wire
        1) 004340 -22/4 Stranded overall aluminum shield plenum
    c. Lake Cable LLC
        1) P224CS Stranded overall aluminum shielded plenum
    d. Or approved equal
3. Personnel gate /Communication Cabling
    a. Windy City Smartwire Waterwarrior minimum 2 ea. Part # 714410VNQ (pedestals)
    b. Windy City Smartwire Water warrior minimum 1 ea. Part # 714410VNQ and 1ea. Part # 714310VNQ (Personnel Gates)
    c. Or TxDOT approved equal

Z. Electronic Surveillance
1. Network Video Recorder
    a. American Dynamics Video Edge Series NVR
2. Cameras single sensor
    a. Tyco Illustra Pro IP series cameras
3. Cameras Multi Sensor
    a. Hanwha PNM-9002VQ Multi Sensor Camera
    b. Hanwha PNM-9022V Multi Sensor Camera

AA. Pathway Cable Support
1. Panduit J-Mod Cable Support System
2. Erico – CADDY CAT LINKS J-Hook Series
3. Panduit Plenum Rated Hook & Loop (Black)

BB. Labeling
1. Permanent Printed Labels for Cables

CC. Fire Stop
1. Shall match or exceed wall ratings
2. Shall be UL classified fire rated sealant
3. ST I Spec Seal
4. 3M Products

DD. Network Cabling
1. Category 6 Cable
    a. Paige DATACOM SOLUTIONS GameChanger Cable Plenum Rated - 258300336
    b. Paige DATACOM SOLUTIONS GameChanger Cable Direct Burial – 258330804
    c. Or TxDOT Approved Equal
2. UTP Jack Module
    a. Panduit Mini-Com CJ688TGOR Cat 6, RJ45, 8-Position, 8-wire universal module. Orange
    b. Or TxDOT approved equal
3. Network Patch Panel

a. Panduit-Mini-Com CPPL24WBLY 24-port modular patch panel with faceplates
b. Or TxDOT approved equal

4. Network Patch Cable - All patch cables shall be factor made and orange in color.
   a. 23/4/PR CAT6e 350 MHZ shielded plenum rated (Indoor use only)
5. Network Surface Mount Box
   a. Panduit Mini-Com CBX1WH-A surface mount box accepts 1 Mini-Com module
   b. Panduit Mini-Com CBX2WH-A Surface mount box accepts 2 Mini-Com modules
   c. Panduit Mini-Com CBX4WH-AY Surface mount box accepts 4 Mini-Com modules
   d. Or TxDOT approved Equal
6. Network Switch
   a. Netgear M4100 Series
   b. Or TxDOT approved equal
   c.

EE. Fiber Optic Equipment
1. Fiber Optic Cable
   a. Multi-Mode 6 Fiber Indoor/Outdoor 62.5/125um
   b. Multi-Mode 12 Fiber Indoor/Outdoor 62.5/125um
   c. Multi-Mode 12 Fiber Direct Burial 62.5/125um
   d. Single Mode 6 Fiber Indoor/Outdoor
   e. Single Mode 12 Fiber Indoor/Outdoor
   f. Single Mode 12 Fiber Direct Burial
2. Fiber Optic Connectors
   a. Multi-Mode LC Connectors
   b. Single Mode LC Connectors
3. Fiber Optic Fan Out Kits
   a. 6 Fiber
   b. 12 Fiber
4. Fiber Optic Patch Cables assorted lengths
   a. Multi-Mode LC – LC
   b. Single Mode LC - LC
5. Fiber Optic Enclosures
   a. Rack Mount
      1) Panduit FRME1
      2) Or TxDOT approved equal
   b. Wall Mount
      1) Panduit FWME4
      2) Or TxDOT approved equal
6. Fiber Optic Enclosure Accessories
   a. Enclosure Fiber Optic Panels
      1) Panduit ST Loaded Panel FAP6WST Z
      2) Panduit Blank Panel FAPB
      3) Or TxDOT approved equal
7. Fiber Optic Media Converter Devices
   a. Harden PoE+ Injector Converter Copper to Fiber
      1) Transitions Networks SI-IES-121D-LRT
      2) Transition Networks Si-IES-111D-LRT
      3) Or TxDOT approved equal

b. Harden Power Supply
   1) Transition Networks 25130
   2) Or TxDOT approved equal
c. Ethernet Media Converter
   1) Transition Networks SGFEB1040-130
   2) Transition Networks SGFEB1040-330
   3) Or TxDOT approved Equal

8. Network Fiber Optic SFP Transceiver
   a. Transceiver
      1) Transitions Network TN-GLC-FE-100FX-RGD
      2) Or TxDOT approved Equal
9. Environmental Enclosures
   a. NEMA 3R Enclosures
      1) Hoffman 19”x24”x12” WF3LP
      2) Hoffman 35”x24”x12” WF10LP
      3) Or TxDOT approved equal

PART 3 - EXECUTION

3.1 CODES, ST ANDARDS, REGULATIONS

A. T IA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements – (May 2001)

B. T IA-569-B Commercial Building Standard for T elecommunications Pathways and Spaces - (October 2004)

C. T IA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure - (May 2002)

D. SIA-Security Industry Authority

E. Local

F. ADA-Americans with Disabilities Act

G. NEC-National Electric Code

H. ISO-International Organization for Standardization

I. FCC-Federal Communications Commission

J. UL-Underwriters Laboratories

K. OSHA-Occupational Safety and Health Administration

L. NFPA-National Fire Protection Association

M. NEMA-National Electrical Manufactures Association

N. Plenum Applications

O. Applicable Flame Test: UL 910 (NFPA 262 1990).

3.2 In the event of any conflicts between documents referenced herein and the contents of this specification, the Contractor shall notify the PM in writing of any such occurrences before purchasing or installing any equipment or materials. The PM will notify the Contractor of any actions required to resolve these conflicts. Such actions may include but are not limited to: design changes, equipment, materials and/or installation changes. In any event Contractor shall not supersede specifications and standards from the latest NFPA and NEC latest publications.

3.3 GENERAL REQUIREMENTS

A. Contractor shall comply with the requirements of local Authority Having Jurisdiction (AHJ), State of Texas, the National Fire Protection Association (NFPA), and the National Electrical Code (NEC). If the Contractor identifies any item in the plans or specifications that will not strictly comply with the aforementioned laws, ordinances, and rules, the matter shall be referred to the PM for direction before proceeding with that part of the work.

B. The Contractor shall install the materials in accordance with these specifications and the manufacturer's installation guidelines.

C. All pedestal cabling shall be direct burial rated. All interior cabling shall be plenum rated.

D. No deviations from the plans or specifications shall be made without full consent in writing of the TxDOT Project Manager. The Contractor shall have written approval from the PM for any additional work beyond the Contract Documents prior to beginning such work. If the Contractor does not obtain written approval from the PM prior to proceeding with the work, the contractor shall not be reimbursed for the work.

E. The Contractor shall obtain written permission from the PM before proceeding with any work that would necessitate cutting into or through any part of the building structure such as, but not limited to, girders, beams, floors, walls, roofs, or ceilings.

F. Contractor shall notify the PM a minimum of (2) weeks prior to beginning work and will participate in a pre-construction meeting with the PM to perform a walkthrough and review the scope of work, schedule, and escalation procedures.

G. The Contractor shall maintain a work area free of debris, trash, empty wire reels, scrap wire, etc., and dispose of such items on a daily basis and return the site to the original state of cleanliness. The Contractor shall not use Owner's facilities for the disposal of excess or scrap materials.

H. Equipment and materials installed by the Contractor shall be free of defects and damage.

I. Contractor shall be responsible for the repair of any damage caused by the contractor during the installation.

J. Contractor shall test all wires prior to installation. By failing to perform this testing operation, the Contractor shall accept the wire as compliant and assume all liability for the replacement of the wire at no cost to the Owner should it be found defective at a later date.

K. Contractor shall maintain a set of working specifications, design drawings, and shop drawings to be kept on site at all times and shall update the shop drawings on a weekly basis. Shop drawings shall be made available for inspection at the request of the TxDOT Project Manager.

L. Equipment and materials shall be consistent throughout the installation. Where multiple units of the same type of equipment and materials are required, these units shall be a standard product with the same manufacturer and model number.

M. Equipment and materials shall be delivered and stored in accordance with the manufacturer's guidelines at the Contractor's expense.

N. Contractor shall make all stored equipment and materials available for inspection at the request of the TxDOT Project Manager.

O. All equipment and material used in the installation shall be approved by the manufacturer for the environment in which it is being installed.

P. Wires shall be properly supported in accordance with industry standards at all times. Improperly supported wires shall be corrected by the Contractor at no cost to the Owner.

Q. Contractor shall be responsible to properly protect wiring from damage by other trades during construction.

R. Cables shall be routed at 90-degree angles to the building structure. At no time shall a diagonal pull be installed.

S. The Contractor shall not install wires in conduits or sleeves without nylon bushings. Wires installed through conduits or sleeves without nylon bushings shall be removed and replaced at no cost to the Owner.

3.4 INSTALLATION

A. Coordination
   1. Coordinate with the PM to ensure that adequate conduit is provided and that equipment backboxes are adequate for system installation.
   2. Coordinate with the PM to ensure that adequate power has been provided and properly located for the security system equipment.
   3. Coordinate with the PM to ensure that doors and door frames are properly prepared for electric locking hardware and door position switches.
   4. Coordinate the provision key cylinders. Coordinate cylinder to match grand master keying system of location with the PM and related trades.
   5. Coordinate locations of all devices with the PM prior to installation.
   6. Coordinate and verify the location of each piece of rack mounted equipment with the Owner.

7. Coordinate custom ACS report requirements with the Owner. Submit report formats to the Owner for review and acceptance.
8. Coordinate all initial database partitioning and setup with the Owner prior to initial programming and card holder data entry.
9. Coordinate final camera locations, desired views, and camera housing and mount requirements with the PM prior to installation.
10. Coordinate camera housing and mount finishes with the PM prior to installation.
11. Coordinate finishes and colors of all equipment with the TxDOT Project Manager. Submit all finish and graphics for all equipment in public areas to the PM for approval prior to installation.

B. General
1. Verify acceptance of each type of specified door hardware and strikes for each application with local life safety code officials.
2. Verify fail-safe and fail-secure lock requirements with the TxDOT Project Manager.
3. Verify camera locations as shown on drawings
4. Contractor or equipment manufacturer logos or names shall not be visible on equipment in public areas.
5. Provide tamper proof fasteners for all equipment in public areas. Fastener finish shall match equipment finish.

C. Access Control Software (ACS)
1. ACS Software shall be designed to support multi-tasking / multi-user applications for security systems management. Independent, simultaneous performance of multiple system functions from the File Server or system workstations shall not cause an appreciable reduction in system processing or response time.
2. Reference appendix A for programming requirements.

D. Electronic Surveillance System (ESS)
1. ESS shall be designed to interface with owners current VMS
2. ESS system shall be designed to cover all cameras locations documented on drawings
3. Vendor shall work with manufacture to size all ESS NVRs appropriately. NVR shall be designed with 20% future growth. NVR shall be designed for 30day onsite recording storage NVR shall be configured with dual Network Interface Cards (NIC)

3.5 EQUIPMENT

A. Provide equipment as indicated on the drawings and specified herein. Additional specific installation requirements are as follows:

B. Server
1. Provide equipment as required by Owner.

C. Control Panels
1. Provide a minimum of 20% card reader spare for future new card reader and 20% inputs and outputs available for future needs
2. The control panels shall collect alarm input point status and access control data, multiplex the information, and transmit that data back to the ACS System file server / system workstations.

3. The control panel shall incorporate Flash ROM to allow for efficient firmware update downloads from the system software and/or remotely from the ACS System manufacturer.
4. The control panels shall receive and execute instructions issued automatically or manually from the ACS System file server / system workstation.
5. The control panels shall have memory and logic circuits as required to ensure continued operation of connected devices without degradation in system security in the event that communications with the ACS System file server is interrupted.
6. All system control panels shall communicate with the ACS System file server over an Owner provided communications circuit.
7. The control panels shall provide the following:
    a. Supervised alarm inputs to monitor the status of alarm circuits and report the status information to the ACS System file server.
    b. Control relay outputs for controlling devices by remote command from the ACS System workstations, through time programming or on alarm point activation date on the ACS server. Control relay output contacts shall be rated for 2 A @ 24 VDC.
    c. Flash ROM technology and shall provide for remote update of DGPs firmware.
    d. Supervision of all wiring / circuits between the DGPs and monitored alarm devices. W ire / device supervision shall meet UL 1076 guidelines. All supervision resister will be located at the device and not inside the DGP.
    e. Enough RAM to maintain a minimum card database of 5,000 cards.
    f. Automatic disconnection from the communication circuit upon a communication failure within the DGPs to prevent communication to other DGPs in the circuit from being interrupted.
    g. Enough RAM to operate normally upon loss of communication with the ACS System file server. In addition, the DGPs shall store up to 5,000 card transactions and up to (16) events per potential alarm input, and transmit that data to the ACS System file server as soon as communication is restored.
    h. Activation of a door control relay output and shunting of the intrusion alarm upon verification of a card authorization or request to exit.
    i. Adjustable door control relay activation time through ACS System Software from 1 to 30 seconds on an individual card reader basis. The door shall automatically relock upon closure.
    j. An intrusion alarm indication on the ACS System if the card reader controlled door is opened without an authorized card use or request to exit.
    k. A door prop alarm indication if the card reader controlled door is held open past an adjustable time period after an authorized card use or request to exit. The door prop time delay shall be adjustable through ACS System Software from 1 to 60 seconds on an individual card reader basis.
    l. A wiring chart delineating wire routings, labeling, and all termination points. The chart shall be produced by the Contractor, laminated and housed in a clear plastic sleeve affixed to the inside of the enclosure cover.
    m. A tamper switch to sense the removal or opening of the enclosure cover.
8. Transaction time for authorized cards shall be less than 0.5 second from the time of card read until the door is unlocked.
9. Provide one spare card reader input point and 20 percent spare alarm input points and output point’s after all specified points are initially connected. Sufficient modules shall be provided to accommodate only the number of card readers initially installed, as well as one spare input per control panel at each communications closet or consolidation point.

10. Configure the system such that devices can be connected to spare input points, output points and card reader inputs on the control panel without requiring reconfiguration of the ACS.
11. Configure the control panel communication chains such that no more than 48 card readers (including all possible spare card readers) shall be connected to each control panel chain.
12. Communications
    a. Communications between servers, workstations, and control panel will be based on utilizing the Owner's LAN.
    b. The ACS shall support 10 Base T Ethernet communications between the ACS File Server and the System Workstations, and between the ACS File Server and the control panels.
    c. Communications shall be encapsulated in a TCP/IP network transport layer in a client / server type TxDOT Project Manager.

D. Card Readers
1. Provide card reader as indicated on the drawings.
2. The card reader shall be multi-technology and shall read encoded data from access cards and transmit the data to the DGP.
3. The vendor shall provide and install HID Multi-Technology readers that shall be controlled by the security system workstation(s) or be set on time schedule control of electric locking mechanisms, or both. The vendor shall install the readers within Americans with Disabilities Act standards and specifications. The readers shall:
    a. Be equipped for reading multiple reader technologies such as the HID®13.56 MHz Smart card and the HID® 125 KHz proximity card and shall allow for the utilization of changing technology.
    b. Be flex models that allow for the upgrade of readers to add new functionality or enhancements using flash firmware.
    c. Have a two (or three) – color LED on the face of the reader.
    d. Generate an audible tone to indicate authorized and unauthorized reader use.
    e. Operate if mounted directly on or attached to a metal surface.
    f. Have a minimum read range of four inches for doors and pedestrian gates.
    g. Have a minimum read range of eight inches for gate readers.
    h. Be marked with corresponding permanent label for C●CURE Ultra SE panel location, ACM # and port #. Submit sample and coordinate with TXDOT project manager
4. Gate card readers shall connect to a 2 reader access control edge panel located in the exterior gate network enclosure.
5. Provide manufacturer recommended power to each reader directly from the DGP or a secondary supply. The power supply shall be UL Class 2, power limited and shall provide necessary output voltage to allow the card reader to operate at its maximum specified read range.
6. Wire card reader LEDs to indicate valid and invalid card reads, and door locked and unlocked conditions. All card reader LED indicators shall operate identically.

E. Electric Locking mechanical
1. Interface with electric locking mechanical provided by the door hardware supplier.
2. Wire electric locking mechanism as indicated on the drawings.
3. Wire fail-safe electric locking mechanical in accordance with local codes.

4. Wire fail-secure electric locking mechanical and power supplies such that a fire alarm condition or building power failure shall not affect operation of the lock.

F. Electrified Locking Mechanism Power Supply
   1. Provide power supplies for all ACS electric locking mechanisms as specified with the exception of those noted as having Time-Delay functions as defined by NFPA 101.
   2. Power supplies for time-delay function locks shall be provided by others. The security Contractor shall coordinate with others as necessary to ensure proper ACS operation of all Time-Delay electric locking mechanisms to include the provision of, and final termination of, ACS control and monitoring wire and cable as necessary to facilitate desired operation and integration with the ACS.
   3. Provide power supplies for all electric locking mechanisms (with the exception of fire stair doors). Fail-safe locking devices shall unlock automatically under the following conditions:
      a. Any building fire alarm
      b. Loss of building power
      c. Failure of the power supply
   4. Provide battery chargers and batteries for all power supplies except those for fail-safe locks.
   5. Monitor low battery and power fail alarms for each power supply.

G. Request-to-Exit (REX) Device
   1. Provide request-to-exit (REX) infrared motion sensors for detecting authorized exits through card reader controlled doors as indicated on the drawings. Wire the REX motion sensor to the REX input of the control panel. For doors equipped with electric locking mechanical that are free exiting at all times(i.e. mortise electric locks, electric strikes, etc.), the REX motion sensor shall only shunt the intrusion alarm output and shall not unlock the lock. The REX motion shall be set to provide a 1 second pulse signal to the ACS.

H. ADA Automatic Door Lock Interface
   1. The vendor shall provide, install, or reconnect an interface module to coordinate the door lock with the ADA automatic door opener.
      a. Push button activation on unsecure side of door shall be disable while door is locked. A valid card read shall unlock the door and enable the push button.
      b. Push button activation on secure side of door shall be active all the time. Activation shall coordinate the door to unlock before automatic door actuates.

I. Remote Door Momentary Release Button
   1. The vendor shall provide, install, or reconnect door release push buttons as required
   2. The door release push buttons shall:
      a. Be desk-mounted at TxDOT designated desks
      b. Remotely release electric locks on card reader controlled doors.
      c. Not cause an alarm on the system workstation when activated
      d. Unlock the door and shunt the door contact to a user programmable time-period of no more than 15 seconds when a door release push button is pressed
      e. Not affect the request to exit device operation for doors with free egress hardware

f. The door release button will be connected to the closest Software House I8 board. The input shall be programmed to activate an event to momentarily unlock the door.

J. Duress/Panic Buttons
1. The vendor shall provide and install, or reconnect duress buttons, below counter tops or in the knee space of desks or workstations in accessible locations as designated by PM. Duress buttons shall:
a. Have Double-pull, Double-throw (DPDT) alarm outputs.
b. Be activated by single recessed pushbutton contacts.

K. Vehicle Gate Pedestal
1. Install TxDOT provided pedestal base, pedestal post and associated pedestal assembly for installation as noted on drawings.
2. Furnish all conduit runs to pedestal and gate controllers as indicated on the drawings

L. Gate Monitor
1. Provide and install monitor, cabling and all associated equipment install at the designated location in building. Contractor shall receive approval for the monitor location from the T x DOT PM before installation
2. This monitor will provide live viewing of the cameras selected by the District.

M. Remote Gate Momentary Release
1. Provide and install gate and/or momentary release and all associated equipment installed at the designated location in building. Contractor will get approval for the gate release location from the PM. The gate release will be achieved using standard desktop telephone and through gate release pushbutton.
2. The gate release button shall:
a. Unlock the gate and shunt the gate contact to a user programmable time-period of no more than 10 seconds when a door release push button is pressed.
b. The gate release button will be connected to the closest Software House I8 input board. The input shall be programmed to activate an event to momentarily unlock the gate.
c. Not cause an alarm or notification on the system workstation when activated.

N. Gate Intercom
1. Provide two (2) new IP intercoms on gate pedestal. Program to dial designated location through Owner’s telephone system. IP Intercom shall communicate through direct burial Cat-6 cable to exterior gate network enclosure

O. Glass Break Sensors
1. Provide glass break sensors to provide coverage of all exterior glass covering all glass up to 10 feet from AFG at buildings indicated on drawings. Glass break detectors to monitor glass areas against breakage and create alarm condition upon detection. Contractor will submit a drawing indicating proposed of glass break zones to PM for approval of zones only before installation begins.
2. Device shall meet minimum requirements:
a. Detection technology shall be acoustic.
b. Detection area will be 25’ radius

c. Output contact will be normally closed powered non-alarm / trouble state.

3. Provide the manufacturer recommended power supply. T he power supply shall be UL Class 2, power limited.
4. Glass break detectors shall be zoned together. Zone layout drawings shall be approved by the TxDOT PM prior to installation.
5. Provide label on each glass break detector identifying programmed zone number per Tx DOT standard labeling scheme

P. Device Power Supply

1. Power management shall be provided by a power supply and shall be installed and provide power for all electric door strikes, request to exit devices, door management alarm units, strobes and pre-recorded sounders. All electric-locking mechanisms and remote control locking mechanisms shall be individually fused at the power supply to ensure that a short in one power cable will only blow that fuse and not affect other equipment.
2. Provide U.L. Listed power supplies for all ACS equipment as specified.
3. Provide battery chargers and batteries for all power supplies except those for fail-safe locks.
4. Monitor low battery and power fail alarms for each power supply.

Q. Door/Vehicle Gate/Pedestrian Gate/ Roof Hatch Position Switches

1. Provide normally closed magnetic concealed door position switches, surface mount door position switches, to monitor all the access controlled vehicle gate (entrance and exit sides), access controlled pedestrian gates, roof hatches, exterior doors, overhead doors and on each leaf of card reader controlled doors switches to monitor the open/closed status of doors.
2. Magnetic mounted door position switches to monitor all roof hatches, exterior doors, overhead doors, and on each leaf of card reader controlled doors (double doors). Door position switches shall monitor for door propping, intrusion alarms, and open or closed status. The system shall provide for supervised monitoring of the door position switches. The system shall annunciate each condition individually. The switches shall be concealed whenever possible.
3. Provide double-pole / double-throw (DPDT) contacts if contact is monitored by ACS and Intrusion Detection system.
4. Provide armored cable (as required) from the switch location to the associated junction box in order to conceal the wire.
5. Resistor pack will be installed at end of line.
6. Vehicle gates shall utilize available limit switch contained in the gate operator to monitor the status of the gate.
7. All contact only single doors, overhead doors, and roof hatches shall be home run and each contact will be terminated on its own input. Double doors shall be series together.
8. All overhead doors shall utilize rail mount contacts where possible. Overhead doors unable to utilize rail mount contacts shall recess the contact in the floor and seal with a concrete patch.

R. Access Control Cabling

1. The Contractor shall furnish and install the following as indicated on the drawings and associated equipment schedules and diagrams.

2. The Contractor shall install a10 -foot service loop to be coiled, mounted, and stored at the access control panel above the ladder rack in Equipment Room/Telecommunications Rooms.
3. The Contractor shall install a 5-foot service loop to be coiled, mounted, and stored at each device installed above the ceiling. Service loop will not be mounted to the ceiling tile supports or left on top of the ceiling.
4. Size wire as recommended by manufacturer.
5. Wires shall be routed utilizing the pathways as indicated in the technology drawings. If technology drawings are not included Contractor will get approval for their proposed cable routing from PM before installation.

S. Intrusion Detection Cabling
1. The Contractor shall furnish and install the following as indicated on the technology drawings and associated equipment schedules and diagrams.
2. The Contractor shall install a 10-foot service loop to be coiled, mounted, and stored at the access control panel above the ladder rack in Equipment Room/Telecommunications Rooms.
3. The Contractor shall install a 5-foot service loop to be coiled, mounted, and stored at each device installed above the ceiling. Service loop will not be mounted to the ceiling tile supports or left on top of the ceiling.
4. Size wire as recommended by manufacturer.
5. Wires shall be routed utilizing the pathways as indicated in the technology drawings. If technology drawings are not included Contractor will get approval from the PM before installation.

T. Network Video Recorders
1. All NRV's shall be located in the sites primary network location.

U. Camera System
1. Cameras shall reside on a private network and shall not connect to the TxDOT business network at any time.
2. Cameras shall connect to a vendor supplied network switch located in designated areas in each building
3. Network switches shall be connected with Cat6 or fiber optic cable depending on existing infrastructure and provide a signal path back to primary switch located near NVR. NVR NIC 1 shall be configured to communicate to private camera network. NIC 2 shall be configured to connect NVR to customer VMS on the business network. Switch ports shall be programmed for MAC lock for each used port and all unused ports shall be turned off. Vendor shall work with the Security System Specialist for proper configuration.
4. Camera Configuration
    a. Cameras shall be
    b. Configured for latest Codex
    c. Configured for proper resolution per location.
    d. Configured for 15fps frame rate unless otherwise specified in drawings
    e. Connected to a private network and shall not reside on the TxDOT business network at anytime
    f. Vendor shall work with the Security System Support Specialist for IP addressing

g. Vendor shall utilize the sites current fiber optic infrastructure when possible. If fiber optic infrastructure is not available vendor shall work with TxDOT PM to design the proper infrastructure

5. Cameras shall be installed per manufactures specification.
   a. Cameras mounted to acoustical tile or hard surface shall utilize toggle bolts
   b. Cameras located in high bay areas shall be mounted using a pendent mount that lowers the camera to the proper view height and distance for accurate coverage.
6. Pedestal Gate Camera
   a. Provide camera mounted on gate pedestal. Camera shall communicate through direct burial Cat-6e cable to exterior gate network enclosure
7. Video Monitoring
   a. Contractor shall furnish and install cabling, monitor and IP decoder at designated location to monitor the display of the camera/cameras at designated locations.

V. Exterior Gate Network Enclosure
1. All equipment servicing the gate ACS, ESS and associated network equipment shall be installed in a lockable exterior cabinet adjacent to the gate controller. Enclosure shall be NEMA 3R rated and contain a fan to control temperature. Enclosure shall be mounted and supported by Unistrut. Unistrut supports shall be concreted in the ground. Enclosure shall receive 110vac from the gate controller. Enclosure shall have seal tight pathways to separate high and low voltage cabling to the gate controller.

W. Exterior Gate Network Cabling
1. Gate location within 250m shall have Cat6 cable run from the network switch to the exterior gate network enclosure. Each device requiring a network connection shall have its own Cat6 cable connection. At no time shall a network switch be used at the exterior gate network enclosure. Surge suppression shall be installed on each end of the Cat6 cable to protect equipment.
2. Gate locations over 250m shall have the appropriate 12 strand fiber optic cable run from the network switch to the exterior gate network enclosure. Fiber optic media converter transceivers shall be used to convert ethernet signal to fiber then back to ethernet at both locations. Fiber equipment will be installed inside a lockable cabinet inside the switch room.

X. Network Cabling
1. Network cabling shall meet all national and state code, standard and regulations.
2. Network cabling shall terminate to a modular jack connector on each end.
3. Network cables runs from device to network switch locations shall have the modular jack connection terminate in a vendor supplied patch panel and a surface mount box
4. Network cables runs from device to device shall have the modular jack connection terminate in a surface mount box on each end.
5. Network cables shall be tested and results supplied to the TxDOT PM and Security System Support Specialist
6. Network jumpers shall be factory made. At no time will a handmade network patch cable be accepted.

Y. Fiber Optic Cabling
1. Fiber optic cabling shall meet all national and state code, standard and regulations.

2. Fiber optic cables shall be ran and terminated per the cables specifications. Fiber strand shall be terminated using a fiber break out kit and terminated with the appropriate LC style connectors
3. Fiber optic cables runs from device to network switch locations shall terminate in a vendor supplied fiber network rack patch panel.
4. Fiber optic cables runs from device to device shall terminate in a vendor supplied surface mounted fiber box at each end.
5. Fiber optic connection from device to fiber shall utilize a manufacture made fiber patch cord. Patch cord shall connect from device to fiber termination box with fixed connectors
6. Fiber optic cables shall be tested and results supplied to the TxDOT PM and Security System Support Specialist

3.6 DEMOLITION OF EXISITING CARD ACCESS AND INTRUSION DETECTION SYST EMS

A. The contractor is required to remove all existing devices, wiring and all cabling of all buildings indicated on drawings where contractor is performing work.

B. The existing system must remain functional until new C●CURE system and devices are installed. Doors are to be switched over one at a time to minimize disruption and access to that door.

C. The Vendor shall
1. Cover and protect the furnishings and floor area for demolition of the devices, panels, wiring and cabling at work area prior to commencing work.
2. Patch, paint and repair any holes or devices to leave the wall/door/doorframe with uniform look
3. Clean all areas of scrap materials, dirt, dust, and debris generated in performance of the demolition at the end of each working day to the satisfaction of TxDOT.
4. Clean, repair, or replace any item damaged by the vendor or its subcontractor(s) during the demolition to the satisfaction of TxDOT, and at no additional cost to TxDOT.
5. Replace any ceiling tile that was damaged during installation. Match existing.
6. Remove and dispose of all cables, wiring, and devices from the building during the demolition in accordance with all applicable rules, regulations, codes, laws, ordinances and statutes, etc. The vendor shall obtain TxDOT approval for removal or disposal, or both, of all devices, wiring, cabling and panels.
    a. NOTE: All devices and panels removed from the building shall remain the property of TxDOT.

3.7 PATHWAY CABLE SUPPORT

A. All cables shall be installed and supported in conduit systems, cable trays, cores, sleeves, etc.

B. When cables leave the main pathway systems, they shall be installed and supported in Contractor furnished and installed j-hooks or saddle straps.

C. Use 4 finger channels at security riser location for pathway between panels and power supplies.

D. No cable pathway shall exceed 40% fill ratio.

E. The contractor shall furnish a separate j-hook or saddle strap pathway for each wire type.

F. J-hooks and saddle straps shall be installed no more than five-feet (5') apart on center, using only manufacturer-approved installation methods and hardware.

G. J-hooks shall be furnished with closure clips.

H. Maximum sag between supports shall not exceed twelve-inches (12").

I. Contractor shall establish j-hook and saddle strap pathways and shall coordinate pathways with all other disciplines. Under no-circumstances shall these pathways be used to support other low-voltage applications not included in this specification.

J. Cable Dressing
   1. No nylon cable ties shall be used at any time during the installation of the wire. Velcro only.
   2. Above Ceiling
      a. Contractor shall furnish and install plenum-rated hook & loop straps in plenum-rated airspaces.
         1) The Contractor shall install no more than (1) hook & loop strap between each j-hook or saddle strap or at service loop locations.
   3. Security Controller Locations
      a. The Contractor shall bundle all visible wires with Contractor furnished and installed hook & loop straps.
      b. Hook & loop straps shall be installed twenty-four (24) inches apart on center.
      c. All exposed conductors need to be insulated at point of cable jacket to prevent any shorts from extra conductors or drain wires.

3.8 LABELING

A. Contractor shall verify room numbers and confirm the final room numbering scheme prior to generating any labels.

B. Create and attach a panel schedule to the new panel that includes the description and location of each installed point used within the panel.
   1. Hand written panel schedules shall not be accepted.
   2. Within the Title Block, the panel schedule shall identify the panel name, panel Internet Protocol (IP), panel Media Access Control (MAC), and panel address.
   3. A minimum of two keys shall be left with the designated TxDOT onsite representative upon final inspection.

C. Cables shall be labeled within (6) to (12) inches from the termination point inside the Equipment Room/Telecommunications/Security Control Location Rooms per TxDOT labeling scheme.

D. Cables shall be labeled within (6) inches from the termination point at the device end.

E. Cables shall be labeled identically at both ends.

F. Label all controls as necessary to agree with their function.
   1. Label the cables using a label-maker provided in the TxDOT labeling scheme.

G. All card readers will be labeled per TxDOT labeling scheme

3.9 FIRE STOP

A. Provide fire stop as required.

B. Provide code compliant fire proofing techniques for all penetrations of fire rated partitions and slabs where the penetrations are made by or used for installation of the ACS.

C. Provide fire stops where conduits penetrate fire rated walls and/or floors.

3.10 EXTERIOR STROBE

A. Furnish, install and connect to C●CURE system one each exterior strobe (AMSECO SL-401), or approved equal, at all buildings indicated on drawings. Coordinate final location with PM before installation.

3.11 INTERIOR SPEAKER AND PRE-RECORDED SOUNDER

A. Furnish, install and connect to C●CURE interior ceiling mounted speaker (and pre-recorded sounder, or approved equal, at all buildings indicated on drawings. Coordinate final location with PM before installation.

3.12 WIRING TECHNIQUES

A. Furnish and install all ACS wire and cable with the exception of traveling cable for elevator control and monitoring.

B. Coordinate the routing of wire and cable requiring isolation from power, radio frequency (RF), electromagnetic interference (EMI), telephone, etc. with the PM.

C. Run all wire and cable continuous from device location to the final point of termination. No mid- run cable splices shall be allowed.

D. Secure all cable up and out of the way of electrical, lighting and ceiling grid using UL rated J-hooks or D-rings spaced a maximum of five feet apart. Cable shall not be tied to electrical conduit or ceiling grid hangers nor laid on top of ceiling grid.

E. Cabling shall be labeled to designate what equipment it supports.

F. Cable shall be color coded consistently throughout the installation.

G. Utilize combined cable runs to the equipment room, whenever possible.

H. Utilize existing cable trays.

I. No splicing shall be accepted.

J. All penetrations shall be sealed with approved UL fire stopping.

K. Installation shall be level and plumb at right angles and perpendicular and parallel to building lines.

L. Cabling leading to security panel shall be enclosed within conduit. The conduit shall be sized for future expansion, 1" minimum. Four-inch finger channel is acceptable.

M. Length of cable installed shall not exceed the manufacturer's maximum distance allowed for the component or equipment.

N. Furnish and install all ESS cable such that ample slack is supplied at the device terminating end of the cable to compensate for any final field modifications in camera location. The extra cable (approximately three feet) shall be bundled and wrapped.

O. Wire and cable within DGPs, power distribution cabinets and other security enclosures shall be neatly installed, completely terminated, pulled tight with slack removed and routed in such a way as to allow direct, unimpeded access to the equipment within the enclosure. All wire and cable shall be bundled with Velcro.

P. Provide heat-shrink to insulate all wire connections. The use of electrical tape for connections shall not be acceptable.

Q. Visually inspect all wire and cable for faulty insulation prior to installation.

R. Provide grommets and strain relief material where necessary to avoid abrasion of wire and excess tension on wire and cable.

S. Make connections with solderless devices, mechanically and electrically secured in accordance with the manufacturers' recommendations. Wire nuts are not an acceptable means of connecting wire and cable.

T. Neatly bundle and wrap all horizontally run (above accessible ceilings and not within conduit) wire and cable at nine feet intervals. Provide supports as required. All supports shall be UL listed for the application.

U. All system wiring within vertical riser shafts (as required) shall be bundled, wrapped and Velcro to the structure at nine feet intervals in order to isolate it from other wire and cable within the shaft. Additionally, all wire and cable within the shaft shall be supported at least every two floors using Greenlee Slack Grips (Split Mesh Lace Closing) or approved equal. Provide all personnel and equipment necessary to install and support the cable. All equipment shall be UL listed for the application.

3.13 PANEL AND COMPONENT INST ALLATION

A. Vendor shall meet with designated TxDOT onsite representative to get written approval of exact locations for all devices installed at each facility.

B. All panels shall be mounted on a Unistrut® or fire rated ¾" plywood backboard that is securely anchored to the wall.

C. All cables shall be bundled inside panels with Velcro®. Tie wraps shall NOT be used.

3.14 CARD READERS

A. Vendor shall provide and install HID Multi-Technology readers that shall be controlled by the security system workstations or be set on time schedule control of electric locking mechanism, or both. The vendor shall install readers within Americans with Disabilities Act standards and specifications.

B. Readers shall be flex models that allow for the upgrade to add new functionality or enhancements using flash firmware.

C. Readers shall generate an audible tone to indicate authorized and unauthorized reader use.

D. Readers shall be capable of operating if directly mounted or attached to a metal surface.

E. Readers shall have a minimum read range of four inches for doors and pedestrian gates.

F. Readers shall have a minimum read range of eighteen inches for vehicle gates.

G. Readers shall be marked with corresponding permanent label for C●CURE® Ultra SE panel location.

3.15 CONDUIT, BOXES AND RACEWAYS

A. Install all conduits necessary for a complete installation, but not provided for in the Security Conduit Drawings, in finished areas concealed in chases, furring's, concrete slabs and/or above suspended ceilings. No exposed conduit shall be installed within public areas.

B. Conduit shall be carefully installed, properly and adequately supported as required to comply with the requirements outlined herein and as required by the NEC to provide a neat, workmanlike installation. Horizontal conduit runs shall be supported by clamps, pipe straps, special brackets or heavy iron tie, tied to the black iron structural members supporting the ceiling. Fastening of conduit to masonry walls, floor or partitions require malleable pipe clips with screws and suitable expansion sleeves.

C. All conduit shall be cut accurately to measurements established at the building and shall be installed without springing or forcing.

D. All required inserts shall be drilled-in and all openings required through concrete or masonry shall be saw cut or core drilled with tools specifically designed for this purpose.

E. Swab out and remove all burrs from conduit before any wires are pulled.

F. Lay out and install conduit runs as to avoid proximity to hot pipes. In no case shall a conduit be run within 29.5"/ 75 mm of such pipes, except where crossings are unavoidable and then the conduit shall be kept at least .98"/25 mm from the covering of the pipe crossed.

G. All conduit installation, whether run exposed or concealed, shall be approved prior to installation by the TxDOT Project Manager.

H. All conduit stub ups and panel conduit penetrations shall have plastic bushings installed at the ends.

3.16 POWER REQUIREMENTS

A. 120VAC AC power dedicated to security shall be provided by the electrical contractor for the Security System as indicated on drawings. Coordinate with the PM to establish locations of security dedicated 120VAC AC circuits.

B. Connect to the AC power (provided by electrical contractor) and provide UL listed power supplies and transformers to distribute low voltage power to the system components as required.

C. Provide hinged cover terminal cabinets with tamper switches for all power supplies, transformers and power distribution terminal strips. Provide all conduit and wiring from the AC power facilities to the terminal cabinets.

D. Surge Protection
   1. Provide protection against spikes, surges, noise, and other line problems for all system equipment and components. Refer to Section 2.2 B items 1 thru 4.
      a. Surge protection for vehicle gate readers shall be installed at the gate controller in a weather proof box and inside the building at the panel locations. Grounding will be per manufactures specification.
      b. Surge Protection for vehicle gate IP devices (intercoms, cameras) shall be installed at the gate and inside the building near the point of entry where the cable switches from direct burial to plenum. Grounding will be per manufacture specification.
      c. Surge protection for gate operator disconnect shall be installed inside the gate operator to 230 vac load
      d. Surge protection for pedestrian gate readers shall be installed inside the building at the panel locations. Grounding will be per manufactures specifications.
      e. Surge protection for exterior IP devices (intercom, cameras) shall be installed inside the building near the appropriate network switch. Grounding will be per manufacture specification.

3.17 LABELED DOORS AND FRAMES

A. Any devices that require any frame modifications or drilling shall match the fire rating of the door where the devices are to be installed. The Contractor shall be responsible for replacing any labeled door or frame that is modified without written approval from the TxDOT Project Manager.

3.18 UNDERGROUND PRIVATE UTILITY LOCATING

A. If trenching is required as part of scope of work, the Contractor shall select and employ a company that has a minimum of 5 years of experience performing the appropriate suite of industry standard geophysical equipment or company to search for existing utilities within the limits specified on the project to identify and locate existing utilities within 10 feet of each side of proposed trench route and 5foot radius of pedestal base, Ballard and any fencing post provided.

B. Contractor shall utilize Electromagnetic induction, Magnetic equipment, Ground penetrating Radar, Rodding, Probing or other proven methods.

C. Mapping of Existing Utilities shall include
1. Metallic/Conductive utilities
2. Steel Pipe
3. Electrical
4. Telephone
5. Fiber
6. Utility Service lines
7. Duct banks
8. Natural Gas Lines
9. Water
10. Wastewater
11. Gas/Oil Pipelines
12. Cable TV
13. Storm Sewer
14. Irrigation

D. Interpret the surface geophysics and mark the indications of utilities with paint or pin flags on the ground surface for subsequent depiction on deliverable utility maps. The existing utilities will be designated within the project limits as shown in the drawings

E. Record all marks on electronic field sketches and correlate such data with provided utility records and above ground appurtenances obtained from visual inspection to resolve differences. Denote any utilities found where ownership/utility type is not available from records as “ unknown” facilities.

F. Provide field sketch to TXDOT for survey of the existing utility designating marks and above ground utility appurtenances according to the project control and record the data for subsequent depiction on the plan deliverables.

G. Contractor does not need to anticipate maintenance of traffic for lane closures will be required for completion of professional utility designating work on this project. Normal traffic control, included within this service, is considered standard placement of traffic cones and freestanding warning signage. Traffic control requiring lane closures, traffic detouring, police support, flag persons, etc. is considered additional and may be added to the scope of work at the request of the PM

H. DELIVERABLES

1. 11” x 17” CAD Field Sketch depicting all designated and located utilities. These plans will be delivered to the PM in electronic AutoCAD 2013 or latest version and PDF form.

3.19 T RAINING

A. Coordinate with the Owner to establish a training outline and schedule. Submit a comprehensive training curriculum to the Owner once all preliminary coordination is complete. The Owner will revise and comment on the curriculum as required.

B. The vendor shall provide a competent technician, factory certified and trained in the use and operation of the SW H C●Cure® card access system. T his technician shall train TxDOT employees for a minimum of two separate 2-hour individual scheduled training sessions. Training shall be provided within ten calendar days after the SWH C●Cure® card access system has been installed and is ready for operation, but prior to final payment. The training shall take place on TxDOT premises at a time and date mutually agreed upon by the vendor and TxDOT. Training shall include, but not be limited to:
   1. Badging
   2. Cable labeling
   3. Troubleshooting
   4. Equipment
   5. Hardware
   6. Interface operations
   7. Operation
   8. Safety
   9. Software

C. Record, label, and catalog all training on DVD. Provide the DVD to the Owner for future in-house training sessions and / or reviews. Furnish all temporary equipment necessary for recording all training sessions. Maintain accurate and up-to-date time sheets of all training sessions.

D. The Contractor shall be on call during the warranty period, be available by phone 24 hours a day/7 days a week and shall respond to TxDOT within 30 minutes of TxDOT’s call and be onsite within 24 hrs.

3.20 SYSTEM START-UP

A. The Work shall be complete and ready to operate prior to final acceptance. TxDOT Security Manager must be notified and included.

B. Load the entire initial user database into all programmable systems up to the inaugural day of beneficial use of the Security System. The PM shall assist in establishing procedural guidelines and in defining terminology and conditions unique to the Owner’s operation.

3.21 SUBSTANTIAL COMPLETION

A. TxDOT Security Department must be notified and included.

B. In order to qualify for the TxDOT Project Manager's consideration of Substantial Completion, the Work must, at a minimum, meet the following requirements:
   1. The initial card holder database must be fully loaded into the ACS.
   2. All sub-system interfaces must be complete and operational.
   3. All required operator training must have been provided to the Owner and/or its representatives.

C. Substantial Completion shall not be construed as final acceptance of the Work.

3.22 SYSTEM ACCEPTANCE

A. Final acceptance testing of the Work will be conducted by PM and TxDOT Security Department must be notified and included.

B. Prior to any final acceptance testing, the Contractor shall submit two sets of preliminary (draft) Record Drawings to the TxDOT Project Manager. The preliminary Record Drawings are to be used by the PM to conduct the system final test.

C. Submit a paragraph by paragraph completion matrix indicating completion or delinquency for each item included in the Specification and all subsequent addenda and bulletins as part of the Work. Indicate completion of the requirement by the word "Completed" following each paragraph number. Indicate delinquency for the requirement by the words "To Be Completed" following the applicable paragraph number. Should work on any item be under way, but not yet fully complete, indicate the extent (or lack thereof) of completion to date, and the proposed date of completion.

D. Conduct a complete test of the entire Security System and provide the PM with a written report on the results of that test. During the course of this test, place the integrated Security System in service, and calibrate and test all equipment.

E. Following completion of the initial testing and correction of any noted deficiencies, conduct a ten (10) day burn-in test. The intent of the burn-in test shall be to prove the Security System by placing it in near real operating conditions. During this period, the Security System shall be fully functional and programmed such that all points, interfaces, controls, reports, messages, prompts, etc. can be exercised and validated. Record and correct any system anomaly, deficiency, or failure noted during this period. Scheduling of the final acceptance test shall be based on a review of the results of this burn-in test.

F. Deliver a report describing the results of functional tests, burn-in tests, diagnostics, calibrations, corrections, and repairs, including written certification to the PM, that the complete installed Security System, has been calibrated, tested, and is fully functional as specified herein.

G. Prior to the final acceptance test, coordinate with the PM for security related construction clean-up and patch work requirements. Security equipment closets and similar areas should be free of accumulation of waste materials or rubbish caused by operations under the Contract. At completion of the Work, remove all waste materials, rubbish, the Contractor's and it's subcontractors' tools, construction equipment, machinery and all surplus materials.

H. Upon written notification from the Contractor that the Security System is completely installed, integrated and operational, and the burn-in testing completed, the PM will conduct a final acceptance test of the entire system.

I. During the course of the final acceptance test by the TxDOT Project Manager, the Contractor shall be responsible for demonstrating that, without exception, the completed and integrated system complies with the contract requirements. All physical and functional requirements of the project shall be demonstrated and shown. This demonstration will begin by comparing "as built" conditions of the Security System to requirements outlined in the Specification, item by item. Following the Specification compliance review, all Security System head-end equipment will be evaluated.

J. The functionality of the various interfaces between systems will be tested.

K. Following the Security System head-end equipment and console review, the installation of all field devices will be inspected. This field inspection will weigh heavily on the general neatness and quality of installations, complete functionality of each individual device, and mounting, backbox and conduit requirements compliance.

L. All equipment shall be on and fully operational during any and all testing procedures. Provide all personnel, equipment, and supplies necessary to perform all site testing. Provide a minimum of two employees familiar with the system for the final acceptance test. One employee shall be responsible for monitoring and verifying alarms while the other will be required to demonstrate the function of each device. Supply at least two two-way radios for use during the test. A manufacturer's representative may be present on site to answer any questions that may be beyond the technical capability of the Contractor's employees, if the Contractor so elects or by specific request of the PM or Owner, at no charge to the PM or Owner.

M. Upon successful completion of the final acceptance test (or subsequent punch list retest), the PM will issue a letter of final acceptance.

N. The TxDOT Project Manager retains the right to suspend and/or terminate testing at any time when the system fails to perform as specified. In the event that it becomes necessary to suspend the test, all of the Owner's/TxDOT Project Manager's fees and expenses related to the suspended test will be deducted from the Contractor's retainage. Furthermore, in the event it becomes necessary to suspend the test, the Contractor shall work diligently to complete/repair all outstanding items to the condition specified in the Specification and as indicated on the Drawings. The Contractor shall supply the PM with a detailed completion schedule outlining phase by phase completion dates and a tentative date for subsequent punch list retest. During the final acceptance test, no adjustments, repairs or modifications to the systems will be conducted without the permission of the PM. TxDOT PM must witness testing

3.23 PROJECT CLOSEOUT DOCUMENTATION

A. As-Built Drawings
   1. Drawings shall be provided to the PM at the time of substantial completion. Final payment will not be recommended until drawings are received and approved by the PM
   2. Three (3) sets of drawings depicting the condition of the access control system as installed. All documents to be provided in binders.

3. As-Built drawings shall be produced in AutoCAD 2010 or up to latest version and provided in hardcopy and electronically in .dwg and PDF format.
4. Hardcopy drawings shall be provided in the original size as issued by the PM
5. Drawings shall retain the formatting and title block of the original drawings as issued by the PM.
6. Drawings shall be provided utilizing the original scale and shall include the exact dimensions and locations of all equipment room/telecommunication room layouts, wall elevations, equipment rack elevations, ladder racks, cable tray, sleeves, pathways, card reader locations and labeling scheme.

END OF SECT ION 28 13 00

SECTION 313116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Soil treatment.
2. Metal mesh barrier system.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood preservative treatment by pressure process.
2. Section 076200 "Sheet Metal Flashing and Trim" for custom-fabricated, metal termite shields.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components, and profiles for termite control products.
2. Include the EPA-Registered Label for termiticide products.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of termite control product.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

D. Research/Evaluation Reports: For metal mesh barrier system, from.

E. Sample Warranties: For special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

1.5 FIELD CONDITIONS

A. Soil Treatment:

1. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
2. Related Work: Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.6 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain termite control products from single source from single manufacturer.

2.2 SOIL TREATMENT

A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.

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. Bayer Environmental Science.

b. Ensystex, Inc.
c. Master Builders Solutions.
d. Syngenta.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than three years against infestation of subterranean termites.

2.3 METAL MESH BARRIER SYSTEM

A. Stainless-Steel Mesh: 0.025-by-0.018-inch (0.64-by-0.45-mm) mesh of 0.08-inch- (2.0-mm-) diameter, stainless-steel wire, Type 316.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Termimesh USA Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Prepare work areas according to the requirements of authorities having jurisdiction and according to manufacturer's written instructions before beginning application and installation of termite control treatment(s). Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated, except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, according to requirements of authorities having jurisdiction.

3.3 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
3. Crawlspaces: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
4. Masonry: Treat voids.
5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.

B. Post warning signs in areas of application.

C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.4 INSTALLING METAL MESH BARRIER SYSTEM

A. Install metal mesh barrier system to provide a continuous barrier to entry of subterranean termites, according to manufacturer's written instructions.

1. Fit mesh tightly around pipes and other penetrations and terminate at slab and foundation perimeters.
2. Install mesh under the perimeter of concrete slab edges and joints after vapor retarder and reinforcing steel are in place.

3.5 PROTECTION

A. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

B. Protect termiticide solution dispersed in treated soils and fills from being diluted by exposure to water spillage or weather until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

3.6 MAINTENANCE SERVICE

A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include three months' full maintenance by skilled employees of termite-control-treatment Installer. Include semiannual maintenance as required for proper performance according to the product's EPA-Registered Label and manufacturer's written instructions. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Continuing Maintenance Proposal: Provide from termite-control-treatment Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1. Include annual inspection for termite activity and effectiveness of termite treatment according to manufacturer's written instructions.

END OF SECTION 313116

SECTION 321813 – SYNTHETIC TURF SURFACING

PART 1 – GENERAL

1.2 SUMMARY OF WORK

A. Provide all labor, materials, equipment, and tools necessary for the complete installation of synthetic grass surfacing in areas shown on the Contract Documents. The system shall consist of, but not necessarily be limited to, the following:

1. Two types of synthetic turf
2. Colored Lines
3. Base materials
4. Turf infill materials
5. Splicing materials
6. Adhesive
7. Concrete edge
8. Nailing board
9. Underdrains
10. Drainage Tile

1.3 RELATED WORK IN OTHER SECTIONS

A. The following Sections have Work related to this Section:

1. Section 033000 – Cast In-Place Concrete.
2. Section 312000 – Earth Moving
3. Section 334600 – Sub-Drainage

1.4 SUBMITTALS

A. Product Data: Submit manufacturer’s product data, including installation instructions and subsurface instructions.

B. Samples: Submit samples of synthetic grass and infill.

C. Warranty: Submit manufacturer’s standard 10-year warranty.

1.5 ENVIRONMENTAL CONDITIONS

A. Install synthetic turf surfacing only when ambient air temperature is 35 degrees F or above, and the relative humidity is below 35% or as specified by the product manufacturer. Installation will not proceed if rain is imminent.

B. Install product only when prepared base is suitably free of dirt, dust, and petroleum products, is moisture free and sufficiently secured to prevent unwanted pedestrian and vehicular access.

1.6 QUALITY CONTROL

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section. The Turf Manufacturer:

1. Must be experienced in the manufacturing of tall pile synthetic infill grass systems with the same fiber as specified.
2. Must have at least 5 fields of 65,000 sq. ft. or more of the specified material, fiber, infill material and backing, or similar system, in play in the United States.

B. Installer Qualifications: Company specializing in performing the Work of this Section.

1. The Synthetic Turf Installer must provide competent workmen skilled in this type of synthetic grass installation. All technicians must have installed tall pile synthetic turf.
2. The designated Supervisory Personnel on the project must be certified, in writing by the Turf Manufacturer, as competent in the installation of this material, including seaming and proper installation of the infill mixture.

C. Prior to the beginning of installation, the Synthetic Turf Installer shall inspect the subbase. The installer will accept the sub-base in writing when the General Contractor provides test results for compaction, planarity and permeability that are in compliance with the synthetic turf manufacturer's recommendations and as stated herein.

D. The Synthetic Turf Installer shall provide the necessary testing data to the Owner that the finished field meets the required initial shock attenuation, as per ASTM F1936.

E. Remove defective Work, whether the result of poor workmanship, defective products or damage, which has been rejected by the Owner's Representative as unacceptable. Replace defective work in conformance with the Contract Documents at no cost to Owner.

PART 2 – PRODUCTS

2.1 AGGREGATE BASE

A. Aggregate Base:

1. Crushed angular hard stone. ¾"-1" minus compactible stone as coarse base.
2. ¼" minus compactible stone or stone dust as leveling base.

B. Granular subbase shall consist of a clean washed crushed stone base constructed in two layers.

1. Contractor shall install a geotextile fabric over the approved subgrade.

a. Geotextile fabric shall be a Mirafi 140N or equal
b. Geotextile fabric shall be installed with minimum 6" overlapping joints secured with landscape nails.

2. The base layer shall be a clean washed crushed stone meeting the following:

a. 1-inch crushed stone with a minimum 4" thick finished section
b. Base layer shall be laser graded to a tolerance of ½" in a 10' radial area
c. Sieve Analysis:

Sieve	% Passing
1"	95-100
¾"	70-100
5/8"	60-80
3/8"	30-50
No. 4	20-35
No. 16	12-20
No. 100	5-9 No.
200	1-5

3. The finish layer shall be a clean washed crushed stone meeting the following:

a. ¼-inch crushed stone with a minimum 2" thick finished section
b. Finish layer shall be laser graded to a tolerance of 1/4" in a 10' radial area.
c. Sieve Analysis:

Sieve	% Passing
¼"	100
1/8"	80-100
No. 8	40-60
No. 16	15-35
No. 100	5-9
No. 200	1-5

2.2 SYNTHETIC GRASS SURFACE

A. Synthetic grass shall be two types: Luxury Rec Pro X synthetic turf from XGrass, 205 Boring Drive, Dalton, GA 30721: Phone (877) 881-8477 or approved equal. Local Contact: Tim Mcintyre, tim.mcintyre@xgrass.com

1. Luxury Rec Pro X (All General Lawn Areas)

a. Face Weight: 65 oz/sy
b. Face Yarn Type: Polyethylene
c. Fiber Mass: 10800 denier
d. Pile Height: 1.125 inches
e. Color: Summer Blend
f. Construction: Broadloom tufted
g. Tufting Gauge: 1/4”
h. Primary Backing: Triple Layer Composite Backing, 7.1 oz./sq.y.
i. Secondary Backing: 10.0 oz. Duraflo
j. Total Product Weight: 92 oz./sq.y.
k. Finished Roll Width: 15 ft. untrimmed
l. Warranty: 10-year fade

B. 4.75 lbs./sq.ft. Round Quartz Sand and Top Dressing
1. 4.5 lbs./sq.ft. of RQS (Round Quartz Sand)
2. 1 lb./sq.ft. of Green and Black Top Dressing

C. Splicing Material: 1000 denier coated nylon (Cordura®) 12” wide minimum.

D. Adhesive: Synthetic Turf Adhesive (from Tour Greens)

E. Pressure treated yellow pine for nailer board.

F. All screws and nails shall be galvanized and rated for outdoor use.

G. Use manufacturer’s drainage tile under surfaces for bocce court, horseshoes, and putting green.

H. Provide cups and flags/hole marker for Putting Green.

2.3 INFILL MATERIAL

A. The synthetic infill material shall consist of a blend of graded, silica sand and treated and mixed ground rubber.

1. Sand: specially-graded, dust-free silica sand shall be placed on the turf in a minimum quantity of 1.5 pounds/ square foot and shall include test results that demonstrate the following minimum properties:

a. Color – tan
b. Sand shall be round non-angular in shape
c. Roundness – 0.6+
d. Hardness - 0.6-0.8 on the Mohs Scale
e. Size – 1.00 mm ± 0.15 mm
f. Density – 90 – 95 lbs/ cu ft
g. Dust - < 0.001 %

h. Angle of Repose - < 30°
i. Sand shall be heavy metal safe

2. Rubber: Rubber is SBR ambient (styrene butadiene rubber) rubber, color black, 10-18 mesh, that is 99% fiber free and is heavy metal safe. Rubber shall be placed on the turf in a minimum quantity of 3.5 pounds/ square foot and shall be of the following Mesh Size Distribution:

Mesh Size	% Retained
10	0-15%
12	5-30%
16	40-70%
20	15-35%
30	0-10%
40	0-1%
Pan	0-1%

B. The infill materials shall be installed to allow an exposed fiber of not less than 1/2 inch after finish brushing.

C. Sufficient quantities of the top-dressing infill material must be stored on site at the time of installation to be used 90 days after the completion of the installation to mitigate the differential settling of high traffic zones on the field. This fill addition must be carried out by the Contractor within the time specified above.

PART 3 – EXECUTION

3.1 GROUND PREPARATION

A. General: The ground area to receive the different synthetic grass surfaces are indicated on the Contract Documents.

B. Leveling and Site Preparation: All organic material and organic debris to be removed. Soil to be graded level and stabilized (compacted). Compaction shall be done with mechanical compactors, including vibratory compactors, and/or powered tampers, and rollers.

3.2 CONCRETE EDGE

A. Concrete shall be as specified and furnished in Section 033000 – Cast-In-Place Concrete.

3.3 BASE AND SYNTHETIC GRASS CONSTRUCTION

A. General: The area to be smooth and graded to allow for proper drainage. The overall grade of the playground is not to exceed 1.5%.

B. Nailer Board: Installation of pressure treated or composite board per site requirements.
   1. Concrete edges: Nailer board attached directly to vertical concrete edge with a Tapcon hardware situated 3/4" below concrete grade.

C. Compacted Aggregate Base: Place 3 inches of 3/4" clean aggregate base and 1" of screening as leveling layer compacted to 90% of max density per AASHTO T99 or 3/4" minus compactible stone. Compaction shall be done with mechanical compactors, including vibratory compactors, and/or powered tampers, and rollers.

D. Synthetic Grass: Place turf and cut to fit configuration as shown on Contract Documents. Splice seams. All seams must be attached with splicing film/fabric and adhesive as approved by the manufacturer for this type of installation of their product.

E. Anchoring/Edging: Edges of turf will be secured to nailer board perimeter.

F. Infill: Apply layers of synthetic grass infill evenly with a spreader and broom the turf fibers with a stiff bristle broom to stand fibers up and allow infill to settle into the bottom. Broom in infill round quartz silica sand approximately 3 pounds per square foot.

3.4 TESTING

A. At the time of substantial completion the Contractor shall perform a series of tests by use of an independent testing agency to evaluate the shock absorption characteristics of the field. The tests shall be performed on a 50-foot grid in both directions using an accelerometer in accordance with ASTM F1936 and ASTM F355.

   F355 – Standard Test Method for Shock-Absorbing Properties of Playing Surfaces
   F1936 – Standard Test Method for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field

B. Test the field at a minimum of 12 points and submit the results to the Owner within 30 days of testing. At no point shall any reading exceed 175 Gmax during the life of the warranty. If any point exceeds the maximum deceleration, the Contractor shall make corrections to provide the allowable Gmax deceleration at the Contractor's expense.

3.5 CLEANING AND COMPLETION

A. Protect all installed work from other construction activities as installation progresses.

B. The Contractor shall keep the area clean throughout the construction period and free from debris.

C. On completion of the installation, thoroughly clean surfaces and site of all refuse resulting from the installation process, including track surfaces.

D. Any damage to existing fixtures or facilities resulting from the installation of the synthetic turf system shall be repaired to original condition at the Contractor's expense prior to Substantial Completion and commencement of the Warranty Period.

E. A deficiency list will be produced by the Owner's Representative at the conclusion of the project. All installation project deficiencies not in dispute must be remedied by the Contractor prior to the issuance of a certificate of Substantial Completion.

F. Contractor to provide a written acceptance by the turf manufacturer that the turf and base system is installed in accordance with their recommendations prior to final completion.

END OF SECTION

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative metallic-coated-steel tubular picket fences.
2. Horizontal-slide gates.
3. Gate operators, including controls.

B. Related Requirements:

1. Section 033053 "Miscellaneous Cast-in-Place Concrete" for concrete bases for gate operators, drives, and controls and post concrete fill.
2. Section 281300 "Security Control Hardware Devices" for access control devices installed at gates and provided as part of a security system.
3. Division 26 Sections for electrical service and connections for system disconnect switches and powered devices including, but not limited to, motor operators, controls, and limit switches.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fencing and gates.

1. Include plans, elevations, sections, gate locations, post spacing, and mounting attachment details, and grounding details.
2. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
3. Wiring Diagrams: Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Product Test Reports: For decorative metallic-coated-steel tubular picket fences, including finish, indicating compliance with referenced standard and other specified requirements.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For gate operators to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind Loading:

1. Fence Height: 8 ft.
2. Design Wind Speed: 105 mph.

B. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 DECORATIVE METALLIC-COATED-STEEL TUBULAR PICKET FENCES

A. Decorative Metallic-Coated-Steel Tubular Picket Fences: Comply with ASTM F2408 for light-industrial (commercial) application (class) unless otherwise indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Ameristar Montage Commercial 8’ tall with extended pickets or comparable product by one of the following:

    a. Ameristar Fence Products; an ASSA ABLOY company.

B. Material:

1. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (310 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.60 oz/ft^2 (184 g/m^2), Coating Designation G-60.

C. Posts:

1. End and Corner Posts: Square tubes 2-1/2 by 2-1/2 inches formed from 0.108-inch nominal-thickness, metallic-coated steel sheet or formed from 0.105-inch nominal-thickness steel sheet and hot-dip galvanized after fabrication.

2. Posts at Horizontal-Slide Gate Openings Wider Than 12 Feet: Square steel tubing 4 by 4 inches with 3/16-inch wall thickness, hot-dip galvanized.

D. Post Caps: Formed from steel sheet and hot-dip galvanized after forming.

E. Rails: Double-wall channels.

1. Size: 1-1/2 by 1-1/2 inches.
2. Metal and Thickness: 0.079-inch nominal-thickness, metallic-coated steel sheet or 0.075-inch nominal-thickness, uncoated steel sheet, hot-dip galvanized after fabrication.

F. Pickets: Square tubes.

1. Material for pickets shall be 3/4" square x 14 Ga. tubing.
2. Extend pickets beyond top rail as indicated and press flat and trim to produce spear point shape.
3. Picket Spacing: 4 inches clear, maximum.

G. FABRICATION

1. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
2. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).
3. The manufactured panels and posts shall be subjected to an inline electrode position coating (E-Coat) process consisting of a multi-stage pretreatment/wash, followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be (Black). The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).

Table 2 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Re-sistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

4. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Commercial weight fences under ASTM F2408.
5. Gates with an out to out leaf dimension less than and including 72 inches shall be fabricated using Montage Commercial ornamental panel material and 1-3/4" sq. x 14ga. gate ends. Gate leafs greater than 72 inches shall be fabricated using ForeRunner rails, 17 gauge pickets, intermediate uprights, gussets and 1-3/4" sq. x 14ga. gate ends. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding.

2.3 HORIZONTAL-SLIDE GATES

A. Manufacture: All industrial ornamental cantilever gates shall conform to the Ameristar® TransPort II® gate system, Montage Commercial, match adjacent fencing design, manufactured by Ameristar Perimeter Security USA Inc., in Tulsa, Oklahoma. The project gate schedule shall include the following additional information for each cantilever gate included in the project scope: 26 feet) opening, 8 feet) height, direction as shown on plans gate travel direction.

B. Gate Configuration: Single leaf.
   1. Type: Cantilever slide, with external roller assemblies.

C. Gate Frame Height: 8 feet.

D. Automated vehicular gates shall comply with ASTM F2200, Class III.

E. Materials
   1. The materials used for cantilever gate framing (uprights & diagonal bracing) shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish. The TransPort™ enclosed tracks shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with a yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish.

   2. Material for pickets shall be 1" square x 1/8" wall aluminum pickets on gate systems greater than 24' openings, gate systems less than 24' openings shall have 1" square x 16 ga. steel pickets. Picket on center spacing shall not exceed 5". Pickets shall be securely fastened to face of top and bottom enclosed track extrusions.

   3. Material for gate uprights and diagonal bracing shall be 2" square x ¼" wall aluminum. The cross-sectional shape of the enclosed-track shall confirm to the manufacturers Fast-Trak™ design with as a single extrusion consisting of a 2" x 5" channeled support with integrated 2" x 2" enclosed-track raceway. Gates less than 24' openings shall be constructed as a single track system, gates greater than 24' openings shall be constructed as a dual track system.

   4. Steel material for fence posts and pickets shall be galvanized prior to forming in accordance with the requirements of ASTM A653/A653M, with minimum yield strength of 45,000 psi (310 MPa). The steel shall be hot-dip galvanized to meet the requirements

of ASTM A653/A653M with a minimum zinc coating weight of 0.90 oz/ft2 (276 g/m2), Coating Designation G-90. Material for gate support posts shall be 4" square x 11 Ga. tubing.

5. Suspension Rollers for enclosed tracks shall be used at each support post to track connection. Each truck assembly shall be capable of being adjusted vertically via threaded rod for fine-tune adjustment. Truck assembly shall be constructed in a way so that the primary housing for the truck rollers shall pivot via ball-bearing connection to threaded rod.GATE OPERATORS

F. Gate Fabrication
1. Gate frame uprights and diagonal bracing shall be pre-fabricated and pre-punched to accept frame fasteners. Enclosed track shall be pre-punched to accept gate uprights. Pickets shall be precut to specified length and predrilled to accept picket to track fasteners. Posts shall be precut to specified lengths.

2. Top and bottom enclosed track extrusions shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Diagonal bracing shall be mechanically fastened to vertical gate uprights and intermediate supports, as required by assembly instructions. Pickets shall be mechanically fastened to top and bottom enclosed track, as required by assembly instructions.

3. The manufactured gate components shall be subjected to the Ameristar thermal stratification coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be Black. The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1.

G. Gate Operators:
1. Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency. Provide operation control system with characteristics suitable for Project conditions, with remote-control stations, safety devices, and weatherproof enclosures; coordinate electrical requirements with building electrical system.
   a. Provide operator designed so motor may be removed without disturbing limit-switch adjustment and without affecting auxiliary emergency operator.
   b. Provide operator with UL-approved components.
   c. Provide electronic components with built-in troubleshooting diagnostic feature.
   d. Provide unit designed and wired for both right-hand/left-hand opening, permitting universal installation.
2. Comply with NFPA 70.
3. UL Standard: Manufacturer and label gate operators to comply with UL 325.
4. Emergency Access Requirements: Comply with requirements of authorities having jurisdiction for automatic gate operators on gates that must provide emergency access.
5. Motor Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, within installed environment, with indicated operating sequence, and

without exceeding nameplate rating or considering service factor. Comply with NEMA MG 1 and the following:

6. Voltage: 120 V.
7. Horsepower: Not less than 1/2.
8. Enclosure: Totally enclosed.
9. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
10. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
11. Phase: Polyphase.

H. Gate Operators: Concrete base mounted and as follows:

1. Hydraulic Slide Gate Operators:

a. Duty: Heavy duty, commercial/industrial.
b. Gate Speed: Minimum 60 feet per minute.
c. Maximum Gate Weight: 800 lb.
d. Frequency of Use: Continuous duty.
e. Operating Type: Wheel-and-rail drive with manual release.
f. Hydraulic Fluid: Of viscosity required for gate operation at ambient temperature range for Project.
g. Locking: Hydraulic in both directions.
h. Drive Type: Enclosed worm gear reducers, roller-chain drive.
i. Drive Type: V-belt and worm gear reducers, roller-chain drive.

I. Remote Controls: Electric controls separated from gate and motor and drive mechanism, with NEMA ICS 6, Type 1 enclosure for concrete base mounting, and with space for additional optional equipment. Provide the following remote-control device(s):
1. Card Reader: Refer security spec

J. Vehicle Loop Detector: System includes automatic closing timer with adjustable time delay and loop detector designed to open and close gate. System includes electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. System includes number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement, as recommended in writing by detection system manufacturer for function indicated, at location indicated on Drawings.

K. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
1. Action: Stop gate in opening cycle and reverse gate in closing cycle, and hold until clear of obstruction.
2. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
3. Sensor Edge: Contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit using [**self-coiling cable**] [**gate edge transmitter and operator receiver system**].

a. Along entire gate leaf leading edge.
b. Across entire gate leaf bottom edge.
c. Along entire length of gate posts.
d. Along entire length of gate guide posts.
e. Where indicated on Drawings.

4. Photoelectric/Infrared Sensor System: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.

L. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully retracted and fully extended positions.

M. Emergency Release Mechanism: Quick-disconnect release of operator drive system of the following type, permitting manual operation if operator fails. Design system so control-circuit power is disconnected during manual operation.

1. Type: Mechanical device, key, or crank-activated release.

N. Operating Features:

1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features with capability for monitoring and auditing gate activity. Provide unit that is isolated from voltage spikes and surges.
2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
3. Automatic Closing Timer: With adjustable time delay before closing.
4. Open Override Circuit: Designed to override closing commands.
5. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
6. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
7. Clock Timer: 24-hour, Seven-day programmable for regular events.

O. Accessories:

1. Warning Module: Audio,-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving; compliant with the United States Access Board's ADA-ABA Accessibility Guidelines.
2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.

a. Fail-Safe: Gate opens and remains open until power is restored.
b. Fail-Secure: Gate cycles on battery power, then fail-safe when battery is discharged.

3. External electric-powered solenoid lock with delay timer allowing time for lock to release before gate operates.
4. Fire box.
5. Intercom System: Yes, refer security spec.

6. Instructional, Safety, and Warning Labels and Signs: According to UL 325.
7. Equipment Bases/Pads: Precast concrete, depth not less than 12 inches, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size.

C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M and specifically recommended by manufacturer for exterior applications.

2.5 GROUNDING MATERIALS

A. Comply with requirements of Section 260526 "Grounding and Bonding for Electrical Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 DECORATIVE FENCE INSTALLATION

A. Install fences according to manufacturer's written instructions as indicated in plans.

B. Fence post shall be spaced according to Table 3, plus or minus 1/4”.

C. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade.

D. Fence panels shall be attached to posts with brackets supplied by the manufacturer.

E. Posts shall be set in concrete footers having a minimum depth of 36”.

F. The “Earthwork” and “Concrete” sections of this specification shall govern material requirements for the concrete footer.

G. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.4 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces;
   1. Remove all metal shavings from cut area.
   2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
   3. Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Manufacture spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non- Manufacture parts or components will negate the manufactures’ warranty.

3.5 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.6 GATE OPERATOR INSTALLATION

A. General: Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.

B. Excavation for Support Posts, Pedestals, Concrete Bases: Hand-excavate holes for bases in firm, undisturbed soil to dimensions and depths and at locations as required by gate operator component manufacturer's written instructions and as indicated.

C. Concrete Bases: Cast-in-place or precast concrete, depth not less than 12 inches, dimensioned and reinforced according to gate operator component manufacturer's written instructions and as indicated on Drawings.

D. Vehicle Loop Detector System: Cut grooves in pavement and bury and seal wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

E. Comply with NFPA 70 and manufacturer's written instructions for grounding of electric-powered motors, controls, and other devices.

3.7 GROUNDING AND BONDING

A. Comply with Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fence Grounding: Install at maximum intervals of 1500 feet except as follows:

1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.

a. Gates and Other Fence Openings: Ground fence on each side of opening.

1) Bond metal gates to gate posts.
2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches below finished grade.

C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet on each side of crossing.

D. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

E. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

F. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

G. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
3. Report: Prepare test reports of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

3.9 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, alarms, and limit switches.

1. Hydraulic Operators: Purge operating system, adjust pressure and fluid levels, and check for leaks.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls, alarms, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lubricate hardware, gate operators, and other moving parts.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION 323119

SECTION 328400 - LANDSCAPE IRRIGATION

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. Provide all labor, materials, equipment and services necessary to furnish and install the irrigation system as shown on the drawings and described herein.

1.3 LICENSED IRRIGATOR

A. The design and Installation of the irrigation system shall be under the “Direct” supervision of a superintendent or foreman currently licensed as an Irrigator by the State of Texas.

1.4 SYSTEM DESCRIPTION

A. Irrigation system shall be completed according to all applicable construction standards. Contractor shall provide all offsets, fittings, sleeves, etc., which may be required, but may not be indicated. Carefully investigate the structural and finished conditions affecting all of the work and plan the 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 system and planting, architectural features and other underground facilities.

B. It is the intention of these specifications to install a sprinkler system within the project limits providing proper coverage of the planted areas free from defects in materials and workmanship.

C. Discrepancy in drawings shall be brought to the attention of the Client’s Representative. Contractor assumes full responsibility for work installed without clarification.

1.5 SUBMITTALS

A. Product Data

1. Furnish the articles, equipment, materials, or processes specified by examples in the drawings and specifications per requirements of Division 1. Only approved equals for

product shall be allowed and only with prior written approval by the Client's Representative.

2. Complete material list shall be submitted prior to performing any work. Material list shall include the manufacturer, model number, and description of all materials to be used.
3. Equipment or materials installed or furnished without prior approval of the Client's Representative may be rejected and the Contractor required to remove such materials from the site at his own expense.
4. Approval of any item, alternate or substitute indicates only that the product or products apparently meet the requirements of the drawings and specifications on the basis of the information or samples submitted.
5. All proposed substitutions shall be accompanied with the items it is intended to replace.

B. Record Drawings:

1. The Contractor shall dimension from two permanent points of reference, building corners, sidewalk, or road intersections, etc., the location of the following items:

    a. Connection to existing water lines.
    b. Gate valves.
    c. Routing of irrigation main lines (dimensioned maximum 100' along routing).
    d. Sprinkler control valves.
    e. Routing of control wiring.
    f. Quick-coupling valves.
    g. Sleeves under paving.
    h. Other related equipment as directed by the Client's Representative.

2. Before the date of the final inspection, the Contractor shall deliver the corrected and completed record drawings to the Client's Representative. Delivery of the record drawings will not relieve the Contractor of the responsibility of furnishing required information that may be omitted from the prints.

C. Controller Charts

1. Record drawings shall be approved by the Client's Representative before controller charts are prepared.
2. Provide one (1) revise controller chart for the existing controller.
3. The chart shall show the area controlled by the automatic controller and shall be the maximum size which the controller door will allow.
4. The chart is to be a reduced drawing of the actual as-built system. However, in the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a size that will be readable when reduced.
5. The chart shall be a blackline or blueline print and a different color shall be used to indicate the area of coverage for each station. Each chart/map shall be specific to each controller. The controller coverage shall be graphically dominant in appearance with the adjacent control areas shaded back but still discernable.
6. When completed and approved, each chart shall be hermetically sealed between two (2) pieces of clear plastic lamination material, each piece being a minimum of ten (10) mils thick.

7. These charts shall be completed and approved prior to final inspection of the irrigation system.

1.6 QUALITY ASSURANCE

A. Qualifications: List statements of qualifications for contractor employed designers (for parts not designed by an A/E or consultant), manufacturers, fabricators, welders, installers, and applicators of products and completed work. The following subparagraphs represent the standard master specification qualification language:

1. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.
2. Installation Qualifications: Company specializing in performing Work of this Section with minimum ten years documented experience.
3. Supervision: Provide the services of a qualified and experienced superintendent who shall constantly be in charge of the work of this section and who shall remain at the site at all times that work is in progress.
4. Regulatory Requirements: All local, municipal and state laws, rules and regulations governing any portion of this work shall be made a part of these specifications and their provisions carried out. However, when specifications or drawings describe materials, workmanship of construction of better quality, or larger size, it shall take precedence over the rules and regulations.
5. Certifications: Include statements to certify compliance with certain requirements. This includes certification of controller adjustments and alterations.

1.7 PROJECT REQUIREMENTS

A. The Contractor shall erect such fences of guards for the protection of the public and his materials, and shall maintain same in good condition until completion of work.

1.8 EXISTING CONDITIONS

A. Prior to submitting bid, thoroughly examine all Contract Documents. Discrepancies, omissions, or conflicts in the contract documents, or doubt as to the meaning thereof, shall be brought to the attention of the Client's Representative prior to the opening date. Addendum will be issued to clarify the discrepancies, omissions, conflicts, or meaning and it shall become a part of the contract. Oral instructions are not valid under this section of the specifications.

B. Before submitting a bid, visit the premises and become familiar with all existing conditions pertaining to the execution of the work contemplated under this section. No request for additional payment due to failure to allow for working conditions will be valid.

C. Paving and landscape headers shall be in place prior to installation of sprinkler heads.

D. Scarifying and/or loosening of soil in planting areas specified under another Section shall be done prior to installation of any pipe.

E. Obtain Client's Representative's approval of rough grades prior to the installation of any pipe.

1.9 WARRANTY

A. The entire sprinkler system, done under this Contract, shall be guaranteed against all defects and faults of material and workmanship, and sustain in working order for one (1) year from date of completion without expense to the Owner.

B. Materials used shall carry a minimum one (1) year manufacturer's guarantee over and above Contractor's guarantee.

C. If, during that period, settlement occurs and adjustments in pipes, valves and sprinkler heads, planting areas or paving are necessary to bring the system to the proper level of the permanent grades, the Contractor shall make all adjustments without extra cost to the Owner.

D. After the system has been completed, the Contractor shall instruct the Owner in the operation and maintenance of the system.

E. Contractor shall not be held responsible under the above guarantee for damage arising from acts of God, vandalism, negligence, or inadequate maintenance by Owner during the maintenance period.

1.10 MAINTENANCE

A. Operation and Maintenance Manuals:

1. Prepare and deliver operation and maintenance manuals as follows:

    a. Catalog and parts sheets on every material and equipment installed under this contract.
    b. Guarantee statement.
    c. Complete operating and maintenance manuals.

2. In addition to the above-mentioned maintenance manuals, provide the Owner's maintenance personnel with instructions for operation of major equipment and show evidence in writing to the Client's Representative at the conclusion of the project that this service has been rendered.

B. Equipment to be furnished

1. Supply as a part of the contract the following tools:

    a. Two (2) sets of special tools required for removing, disassembling and adjusting each type of sprinkler and valve supplied on this project.
    b. One quick-coupling key and matching hose swivel for every six (6), or fraction of, quick-coupling valves shown on the drawings.

C. The above-mentioned equipment shall be turned over to the Owner at the conclusion of the project. Before final inspection may occur, evidence that the Owner has received material must be shown to the Client's Representative.

PART 2 - PRODUCTS

2.1 PRODUCTS

A. General: Use only new materials of types and descriptions noted on the drawings and in currently use at the project site. Mix of manufacturers is not permissible.

2.2 MATERIALS

A. Backfill Material: Existing site material, if approved by Client's Representative, shall be used for backfill material. Backfill material shall be free from organic materials, large clods of earth or rocks larger than one (1) inch diameter, trash, debris, rubbish, broken cement, asphalt material or other objectionable substances.

2.3 MANUFACTURED UNITS

A. Pressure Main Line

1. Pressure main line piping for sizes one-and one-half (1-1/2) inch up to and including three (3) inch shall be PVC schedule 40 with solvent-welded joints.

    a. Pipe shall be made from NSF approved Type I, Grade I, PVC compound conforming to ASTM resin specification D1785. All pipe shall meet requirements set forth in Federal Specification PS-21-70. (Solvent-weld Pipe).
    b. Use Schedule 40 PVC solvent weld couplings.

2. Pressure main lines piping four (4) inch and larger shall be gasketed (PVC)1120 Class 200 SDR 21.

    a. All gasketed pipe to conforms to material requirements of ASTM D2241 in accordance with ASTM D1784.
    b. Join lengths of gasketed pipe by means of integrally formed bell end on pipe using rubber ring seal.

3. All PVC pipe shall bear the following markings:

    a. Manufacturer's name.
    b. Nominal pipe size.
    c. Schedule or class.
    d. Pressure rating in psi.
    e. National Sanitation Foundation (NSF) approval.
    f. Date of extrusion.

4. All fittings shall bear the manufacturer's name or trademark, material designation, size applicable, psi, schedule and NSF seal of approval.

B. Fittings:

1. Gasketed Main Line: At changes in direction or branch mains, use appropriate one-piece ductile iron rubber ring seal fittings in 4" and larger sizes; Class 200 PSI PVC one-piece molded rubber ring seal fittings in 3" sizes; all fittings as approved by the Uniform Plumbing Code

    a. 3" and smaller branch mainlines shall be connected to 4" and larger mainlines by means of double strap stainless-steel service saddles.
    b. 4" and larger PVC pipe shall use ductile iron flange coupling adapter.

C. PVC Non-Pressure Lateral Line Piping

1. Non-pressure buried lateral line piping shall be PVC 1120 Class 200 .
2. Pipe shall be made from NSF approved Type I, Grade II PVC compound conforming to ASTM resin specification D1784. All pipe shall meet requirements set forth in Federal Specification PS-22-70, with an appropriate standard dimension ratio (SDR).
3. All requirements for non-pressure lateral line pipe and fittings shall be the same as for solvent-weld pressure main line pipe and fittings as set forth in Section 2.3A of these specifications.

D. Gate Valves

1. Gate Valves 2 ½" and smaller shall be bronze construction with operating wheel and screwed connections. Install in 10" diameter heavy duty plastic valve box. Use concrete valve box in paved or hardscape areas including gravel and decomposed granite areas.
2. Gate Valves 3" through 10" shall be epoxy coated cast iron with operating nut (2" square) and "0" ring connections for PVC plastic pipe and resilient seat. Install in appropriate valve box.

    a. Roadway locations: Cast iron valve box complete with PVC sleeves. Cast iron cover.
    b. Landscaped areas: Christy F8 box or equal with F8D reinforced concrete lid marked "GV". Perimeter Cap and Lid to have polypropylene or polyethylene cap.
    c. Concrete or sidewalk areas: Christy G5 traffic box or equal with G5C traffic rated cast iron lid marked "GV". Box to have cast iron perimeter ring cap and lid seat.

E. Quick Coupler Valves

1. Quick-coupling valves shall have a brass or bronze two-piece body designed for a working or static pressure of 150 psi operable with quick coupler key. Quick coupling keys shall be of a type designed to operate quick coupling valve.

F. Remote Control Valves

1. All remote control valves shall be the type and size shown on the drawings.

G. Valve Boxes

1. 2-½" and smaller gate valves and quick couplers in lawn areas: Use heavy duty ten inch diameter (10"Ø) round plastic valve box with bolt-down lid for all gate valves and quick couplers; example Brooks #910 or approved equal. Color to be black.
2. Remote Control Valves in lawn areas: Use heavy duty plastic valve box with bolt-down lid for remote control valves; No smaller than Carson #1419 or approved equal. One valve per box. Color to be black. Size box to accommodate remote control valve, ball valve, and unions to facilitate maintenance

H. Automatic controllers

1. Multiple start time programming.
2. Minimum 3 cycles preprogram capability.
3. Operation information including recommended monthly and seasonal schedules, water budgets based on gallons used or landscape planting for year one and year three, with the irrigation plan and documentation.
4. Independent rain and freeze shut-off device.
5. Locking capability, pedestal mounted.
6. Controller shall be capable of two-wire decoder control of up to 99 stations via a plug-in decoder output module. The decoder output module shall be field-installable without tools, and only a screwdriver to make the two-wire path connections.
7. System shall be grounded per manufacturer's recommendations

I. Controller Wiring Connections between the automatic controllers and the electric control valves shall be twisted pair, solid-core, color-coded red/blue pairs, enclosed in a PE sleeve available in 6 different colors for in-ground identification. The two-wire paths shall be Hunter Industries Model ID1xxx for 14 AWG (1.5mm) conductors, or Model ID2xxx for 12 AWG (2mm) conductors for extended range (over 10,000 ft./3km, up to 15,000 ft./4.5km), where "xxx" indicates the external sleeve color-code.

1. Wire shall occupy the same trench and shall be installed along the same route as pressure main line wherever possible.
2. Where more than one wire is placed in a trench, the wiring shall be taped together neatly at intervals of ten feet (10').
3. An expansion coil shall be provided within three feet (3') of each wire connection. Expansion coil shall be of sufficient length at each splice connection at each remote control valve, so that in case of repair, the valve bonnet may be to the surface without disconnection of the control valve wires. Control wires shall be laid loosely in trench without stress or stretching of control wire conductors.
4. The two-wire paths may be spliced, or "teed", permitting extensions of the path in multiple directions. In general, the distance from the controller to the end of any one end of a "tee" or wire run shall not exceed the maximum for the gauge of wire, even if the total of all wire exceeds that number. For example, a path comprised of IDWIRE1 (rated for 10,000ft./3km) could extend 5000 ft./1.5km to a "tee" splice, and each arm of the tee could extend an additional 5000 ft./1.5km. The total wire connected would equal 15,000 ft./4.5km, but the distance from the controller, to the end of each run, would be 10,000ft./3km or less, meeting the specification. All wire splices must be made in a valve box with DBR-6 or equal direct-burial waterproof connectors.

J. Decoders

1. Compatible decoders include only the Hunter ICD Series as described herein. ICD Series decoders are available in four different station output configurations, and shall be selected and placed to minimize the wiring distance from decoder to solenoid. The maximum distance recommended between individual decoder outputs, and the solenoids they are to activate, is 100 ft./33m.
2. The Sensor Decoder shall have a bare ground wire for connection to earth ground, in accordance with the specifications applying to all other decoders. The Sensor Decoder shall count as a “decoder” for ground spacing purposes.

K. Double Check Assembly (Backflow Device)

1. The Double Check Valve assembly shall consist of a bronze body with bronze caps. The body shall be a "Y" pattern design incorporating two spring loaded, center guided check assemblies. The assembly shall include threaded inlet and outlet, full port ball valve shut-off valves and four ball valve test cocks. All internal parts shall be of corrosion resistant materials.

L. Pressure Regulating Device

1. Install at Point Of Connection and at section valve as necessary so that the irrigation components operate within the manufacturers’ recommended operating pressure.

M. Sprinkler Heads

1. All sprinkler heads shall be of the same size, type, and deliver the same rate of precipitation with the radius of throw, pressure, and discharge as listed on the drawings.
2. Spray heads shall have a screw adjustment for radius.
3. Riser units shall be fabricated in accordance with the details.
4. Rotors to be gear driven, on stainless steel risers.
5. Head to include screens and pressure regulating device where require.
6. Provide heads that prevent downpipe draining of system
7. Rotors and Pop Up Heads to have wiper seals
8. Rotors and Pop Up Heads to have positive retraction
9. Part circle rotors to have memory adjustment capability

N. Valve Manifold and Riser Fittings

1. Connect between main lines and remote control valves shall be of schedule 80 PVC (threaded both ends) nipples and fittings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Site Conditions

1. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions and receive Client's Representative'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 operation or neglect. Check existing utility drawings, and contact the appropriate utility companies to determine existing utility locations.
3. Coordinate installation of sprinkler irrigation materials, including pipe, so there is no interference with utilities or other construction or difficulty in planting trees, shrubs, and ground covers.
4. The Contractor shall carefully check all grades to satisfy himself that he may safely proceed before starting work on the sprinkler irrigation system.

3.2 PREPARATION

A. Physical Layout

1. Prior to installation, the Contractor shall stake out all pressure main supply lines, routing and location of sprinkler heads and lateral lines.
2. All layouts should be approved by Client's Representative prior to installation.
3. Run pipelines and automatic control wiring in common trenches wherever practical. Where mainlines are installed outside of common trench from control wiring, install copper tracer wire and attach to top of pipe with 10 mil polyethylene tape wrapped around pipe at 10 foot intervals. Stub tracer wire into valve box at each end.
4. Install pipelines and wire within 1120-200 PSI PVC Plastic Pipe Sleeving when passing beneath hardscape in excess of 6' across.

B. Water Supply

1. Sprinkler irrigation system shall be connected to water main supply points of connection as indicated on the drawings.

3.3 INSTALLATION OF PIPE

A. Trenches located under areas where paving, asphaltic concrete or concrete will be installed shall be backfilled with sand (a layer 6 inches below the pipe and 3 inches above the pipe) and compacted in layers to ninety-five percent (95%) compaction, using manual or mechanical tamping devices. Trenches for piping shall be compacted to equal the compaction of the existing adjacent undisturbed soil and shall be left in a firm, unyielding condition.

B. Provide for a minimum cover of thirty inches (36") between the top of the pipe and the bottom of the Aggregate base for all pressure and non-pressure piping installed under roadway paving. Provide fittings and thrust blocks where required to route around gravity based utilities such as sanitary and storm sewers. Maintain required clearances between utilities.

C. Excavation shall be in all cases ample in size to permit the pipes to be laid at the elevations intended and to permit ample space for joining.

D. Make trenches for pipelines deep enough to provide minimum cover from finish grade as follows:

1. 20” minimum cover from top of all pipes to pavement subgrade in roadway, driveway, and parking areas. This applies to gravel trafficable surfaces also.
2. 18” minimum cover over all pressure main lines outside of paved areas
3. 18” minimum cover over low voltage control wires from controller to valves.
4. 18” minimum cover over sensor cable.
5. 18” minimum cover over lateral lines to rotor sprinkler heads and 12“ pop-up heads.
6. 12” minimum cover over lateral lines to other type sprinkler heads.

3.4 ASSEMBLING PIPE

A. All pipe shall be assembled free from dirt and pipe scale. Field cut ends shall be reamed only to full pipe diameter with rough edges and burrs removed.

B. Rubber Ring Seal Joint:

1. Use factory-made male end or prepare field-cut male end to exact specifications of factory-made end.
2. Carefully clean bell or coupling and insert rubber ring without lubricant. Position ring carefully according to manufacturer’s instructions.
3. Lubricate male end according to manufacturer’s instructions and insert male end to specified depth. Use hands only when inserting PVC pipe.
4. Thrust blocks shall be provided where necessary to resist system pressure on ring-tite pipe and fittings. Blocks shall be of Class “B” concrete and the size shall be based on an average soil safe bearing load of 2000# per square foot.
5. Form thrust blocks in such a manner that concrete comes in contact only with the fittings. Thrust blocks shall be between solid, undisturbed soil and the fittings.

C. Solvent Weld Joint:

1. Prepare joint by first making sure the pipe end is square, then deburring the pipe end and cleaning pipe and fitting of dirt, dust and moisture.
2. Dry-insert pipe into fitting to check for missing. Pipe should enter fitting 1/3 to 2/3 depth of socket.
3. Coat the inside socket surface of the fitting and the fitting and the male end of the pipe with P-70 primer (manufactured by Weld-On). Then without delay, apply Weld-On 711 cement liberally to the male end of the pipe and also apply 711 cement lightly to the inside of the socket. At this time, apply a second coat of cement to the pipe end.
4. Insert pipe immediately into fitting and turn ¼ turn to distribute cement and remove air bubbles. The pipe must seat to the bottom of the socket and fitting. Check alignment of the fitting. Pipe and fitting shall be aligned properly without strain to either.
5. Hold joint still for approximately thirty (30) seconds and then wipe the excess cement from the pipe and fitting.
6. Cure joint a minimum of thirty (30) minutes before handling and at least six (6) hours before allowing water in the pipe.

D. Threaded Joint:

1. Field threading of plastic pipe or fittings is not permitted. Factory-formed threads only will be permitted.
2. Factory-made nipples shall be used wherever possible. Field-cut threads in metallic pipe will be permitted only where absolutely necessary. When field threading, cut threads accurately on axis with sharp dies.
3. All threaded joints shall be made up with compatible pipe joint compound. Apply compound to male threads only.
4. Where assembling metallic pipe to metallic fitting or valve, no more than three (3) full threads shall show when joint is made up.
5. Where assembling to threaded plastic fitting, take up joint no more than one full turn beyond hand tight.
6. Where assembling soft metal (brass or copper) or plastic pipe, use strap type friction wrench only; do not use metal-jawed wrench.

E. Cap or plug openings as pipeline is assembled to prevent entrance of dirt or obstructions. Remove caps or plugs only when necessary to continue assembly.

F. Where pipes or control wires pass through sleeves, provide removable non-decaying plug at ends of sleeve to prevent entrance of earth.

3.5 INSTALLATION OF IRRIGATION LATERALS

A. Assemblies

1. Routing of sprinkler irrigation lines as indicated on the drawings is diagrammatic. Install lines (and various assemblies) in such a manner as to conform to the details per drawings.
2. Install no multiple assemblies on plastic lines. Provide each assembly with its own outlet.
3. Install all assemblies specified herein in accordance with the respective detail. In absence of detailed drawings or specifications pertaining to specific items required to complete work, perform such work in accordance with the best standard practice with prior approval of Client's Representative.
4. PVC pipe and fittings shall be thoroughly cleaned of dirt, dust, and moisture before installation. Installation and solvent-welding methods shall be as recommended by the pipe and fitting manufacturer. PVC pipe shall be installed so that there will be a small amount of excess length in the pipe to compensate for contraction and expansion of the pipe. This shall be accomplished by "snaking" the pipe in the trench during installation.
5. On PVC to metal connections, the Contractor shall work the metal connections first, Teflon tape or approved equal shall be used on all threaded PVC to PVC joints, and on all threaded PVC to metal joints. Light wrench pressure is all that is required. Where threaded PVC connections are required, use threaded PVC adaptors into which the pipe may be welded.
6. In changing pipe depth, 45 degree elbows shall be used.

B. Line Clearance

1. All lines shall have a minimum clearance of three inches (3") from each other and six) inches (6") from lines of other trades. Parallel lines shall not be installed directly above one another.

C. Remote Control Valves

1. Install where shown on Drawings and group together where practical. Limit one remote control valve per box - No Exceptions.
2. Locate valve boxes 12" from and perpendicular to walk edges, buildings and walls. Provide 12" between valve boxes where valves are grouped together.
3. Thoroughly flush main line before installing valve.
4. Install in shrub or ground cover areas where possible.
5. Label control line wire at each valve with a 2¼"" x ¾" polyurethane I.D. tag, indicating identification number of valve (controller and station number). Attach label to control wire.

D. Controller Wires

1. Run lines along mains wherever practical. Tie wires in bundles with pipe wrapping tape at 10 foot intervals and allow slack for contraction between bundle points.
2. Loop a minimum of three (3) feet of extra wire in each valve box; both control wire and ground wire.
3. Connections shall be made by twisting wires within wire nuts and sealing with specified seal packs.
4. Locate all splices at valve locations within valve boxes.
5. Where control lines pass under paving, they shall pass through PVC sleeves.

E. Sprinkler Heads and Quick Coupling Valves (QCV)

1. Thoroughly flush lines before installing heads or QCV's.
2. Locate heads and QCV's as shown in the Drawings and Details.
3. Adjust sprinkler heads for proper distribution and trim.
4. Install lawn heads 2" above grade in seeded lawn area at time of installation. Lower to finished grade after turf is well established and as directed by Client's Representative.

3.6 RESTORATION

A. Restore surfaces, utilities, existing underground installations, etc., damaged or cut as a result of excavations, to original conditions in manner approved by Client's Representative.

B. Where other utilities interfere with irrigation trenching and pipe work, adjust the trench depth as instructed by Client's Representative.

C. Initial Backfilling

1. The trenches shall not be backfilled until all required tests are performed.
2. 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 landscape areas to a dry density equal to adjacent undisturbed soil in planting areas. Backfill will conform to adjacent grades without dips, humps, sunken areas, or other surface irregularities.

3. A fine granular material backfill is to be initially placed on all lines. No foreign matter larger than one -half inch (1/2") in size will be permitted in the initial backfill.
4. If settlement occurs and subsequent adjustments in pipe, valves, sprinkler heads, lawn or planting, or other construction are necessary, the Contractor shall make all required adjustments without cost to the Owner.

3.7 TESTING

A. Perform test as specified below. Remake any faulty joints with all new materials. Use of cement or caulking to seal leaks is prohibited.

B. The Contractor shall:

1. Notify Client's Representative at least three (3) days in advance of testing.
2. Perform testing at his own expense.

C. Center load piping with small amount of backfill to prevent arching or slipping under pressure. No fitting shall be covered.

D. Apply the following tests after welded plastic pipe joints have cured at least 24 hours.

1. Hydrostatic pressure and leakage test shall be conducted as outlined in Section 22, AWWA Standard C600-54T. Testing shall be done in the presence of the Owner's Representative.
2. No trenches shall be backfilled until they have been inspected and accepted by the Owner's Representative. Two calibrated gauges 0-200 psi shall be installed on the main line piping system. All pipe and valves, including quick-coupling valves, shall be installed.
3. Apply continuous static water pressure of 125 psi to main line with no drop in gauge reading for two (2) hours. Owner's representative shall witness test for entire two hour period. Leaks resulting from test shall be repaired and test repeated until system passes test.

E. When the sprinkler irrigation system is completed, perform a coverage test in the presence of the Client's Representative to determine if water coverage for lawn and planting areas is complete and adequate. Furnish all materials and perform all work required to correct any inadequacies of coverage do to deviations from plans or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate due to site conditions, without bringing this to the attention of the Client's Representative. This test shall be accomplished before any groundcover is planted.

F. Upon completion of each phase of the work, entire system shall be tested and adjusted to meet site requirements.

3.8 FINAL BACKFILLING

A. Final backfill only after piping has been tested, inspected and approved.

B. Backfill material shall be the earth excavated from the trenches, free from rocks, concrete chunks, and other foreign or coarse materials. Carefully select backfill that is to be placed next to plastic pipe to avoid any sharp objects which may damage the pipe.

C. All pipe under asphalt paving shall be backfilled with 4” of clean sand on all sides of pipe.

D. Place backfill materials in 6” layers and compact by jetting or tamping to a minimum compaction of 90 percent of original soil density.

E. Dress off areas to finish grades and remove excess soil, rocks or debris remaining after backfill is completed.

F. If settlement occurs along trenches, and adjustments in pipes, valves and sprinkler heads, soil, sod or paving are necessary to bring the system, soil, sod or paving to the proper level or the permanent grade, the Contractor, as part of the Work under this contract, shall make all adjustments without extra cost to the Owner.

3.9 ADJUSTING THE SYSTEM

A. The Contractor shall flush and adjust all sprinkler heads for optimum performance and to prevent over spray onto walks, roadways, buildings, and adjacent areas as much as possible.

B. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments prior to planting. Adjustments may also include changes in nozzle sizes and patterns as well as location.

C. Lowering raised sprinkler heads by the Contractor shall be accomplished within ten (10) days after notification by the Owner.

D. All sprinkler heads shall be set perpendicular to finish grades unless otherwise shown on the drawings.

E. Contractor shall be responsible for all adjustments until the system has performed without issue for one week and until final acceptance of the project.

3.10 CLEAN-UP

A. Clean-up shall be made as each portion of the work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be broomed or washed down, and any damage sustained on the work of others shall be repaired to original conditions acceptable to Client’s Representative and A/E.

3.11 GUARANTEE

A. It shall be the responsibility of the Contractor to fill and repair all depressions and replace all necessary lawn and planting due to the settlement of irrigation trenches for one year following completion and acceptance of the job.

B. Contractor shall also guarantee all materials, equipment and workmanship furnished by him to be free of all defects of workmanship and materials, and shall agree to replace at his expense, at any time within one year after installation is accepted, any and all defective parts that may be found.

3.12 DEMONSTRATION

A. The Contractor shall operate each system in its entirety for the Client's Representative at time of final observation. Any items deemed not acceptable shall be reworked to the complete satisfaction of the Client's Representative.

B. The Contractor shall show evidence to the Client's Representative that the Owner has received all accessories, charts, record drawings, and equipment as required before final observation can occur.

3.13 OBSERVATION SCHEDULE

A. Contractor shall be responsible for notifying the Client's Representative in advance for the following observations according to the time indicated:

1. Pre-job conference - seven (7) days.
2. Pressure supply line installation and testing - forty-eight (48) hours.
3. Coverage test - forty-eight (48) hours.
4. Final observation - forty-eight (48) hours.

B. When inspections have been conducted by other than the Client's Representative, show evidence of when, and by whom these inspections were made.

C. No observation shall commence without as-built drawings. In the event the Contractor calls for an observation without as-built drawings, without completing previously noted corrections, or without preparing the system for observation, he shall be responsible for reimbursing the A/E at the hourly rate in effect at the time of the observation (portal to portal (plus transportation costs) for the inconvenience. No further observations will be scheduled until this charge has been paid.

END OF SECTION 328400

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SECTION 329113 - PLANTING SOILS

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. Supplying soil that meets the Specifications of this Section for all tree pits, shrub beds, planting beds, and lawn areas, including seeding or sodded areas.

B. Sampling and testing of proposed soil by a qualified soils lab as specified in this Section.

C. Modifying, screening, placing, spreading and grading of approved soil.

D. The site for this project has no existing topsoil for reuse. For the purposes of this Section all references to “Planting Soil” shall mean providing and placing loam or topsoil (obtained from an off-site source) which has been modified to meet the requirements of this Section. The planting soil shall be placed on all sodded and seeded areas, as well as used for backfill for planting pits for trees, shrubs, perennials, and groundcovers.

E. Related Requirements:

1. Section 329300 “Planting.”
2. Section 329213 “Seeding.”
3. Section 329223 “Sodding.”
4. Section 312313 “Subgrade Preparation.”

1.3 SUBMITTALS

A. At least 20 days prior to ordering materials, the Contractor shall submit to the Owners Representative samples, certifications, manufacturer's product data and certified test results for materials as specified below for approval. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Owner’s Representative. Delivered materials shall closely match the approved samples. The Owner’s Representative reserves the right to reject on, or after delivery, any material that does not meet these Specifications.

B. Testing of loam for planting soil mix shall be at the Contractor's expense. Contractor shall deliver all planting soil samples to testing laboratory via overnight courier and shall have the testing report sent directly to the Owner’s Representative. Soil testing shall be done by a certified soils lab such as the Texas A&M Soils, Water and Forage Testing Laboratory, 2478

Texas A&M University, College Station, TX 77843-2478, email: www.soiltesting@tamu.edu., phone 979-845-4816. Perform all tests for gradation, organic content, soil chemistry and pH – A&M labs specify Analysis Suite No 10. Testing reports shall include the following tests and recommendations.

1. Mechanical gradation (sieve analysis) shall be performed and compared to the USDA Soil Classification System. Sieve analysis shall be by combined hydrometer and wet sieving using sodium hexametaphosphate as a dispersant in compliance with ASTM D 422 after destruction of organic matter by H2O2. To facilitate review and approval of sieve analysis, provide a computer generated gradation curve.
2. Percent of organics shall be determined by the loss on ignition of oven-dried samples. Test samples minus #10 material shall be oven-dried to a constant weight at a temperature of 450 degrees Fahrenheit.
3. Chemical analysis shall be undertaken for Nitrate Nitrogen, Ammonium Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, extractable Aluminum, Lead, Zinc, Cadmium, Copper, Soluble Salts, and pH and buffer pH. A Conductivity Meter shall be used to measure Soluble Salts in 1:2 soil/water (v/v). Except where otherwise noted, nutrient tests shall be for available nutrients.
4. Soil analysis tests shall show recommendations for soil additives to correct soils deficiencies as necessary, and for additives necessary to accomplish the work as specified.

    a. Peat Moss: Submit a one cubic foot sample and supplier's certification of contents.
    b. Limestone: Submit supplier's certification that the limestone being supplied conforms to these Specifications.
    c. Acidulant: Submit supplier’s certification that the acidulant being supplied conforms to these Specifications.
    d. Fertilizer :

5. Submit product data of fertilizer and certificates showing composition and analysis. Submit fertilization rates for fertilizer product based upon soil testing, analysis, and recommendations as specified, performed and paid for in this Section, PLANTING SOILS.
6. Submit the purchasing receipt showing the total quantity purchased for the project prior to installation.
7. Gypsum: Submit manufacturer's product data and sample.
8. All additives needed to amend a specific soil in order to meet these Specifications.

1.4 EXAMINATION OF CONDITIONS

A. The Contractor, and any sub-Contractor responsible for the execution of the Work of this Section, shall review the subgrades and verify that the subgrades have been excavated and prepared as required by this Section prior to proceeding with the spreading of the soil mix. Carefully review the requirements of this Section to understand the requirements of percolation testing, compaction, and absence of debris of the subgrade prior to spreading of the soil mix.

PART 2 - MATERIALS

2.1 LOAM - GENERAL

A. DEFINITIONS

1. The following size distributions of mineral particles by diameter and sieve size shall apply to the following conventional names of soil types:

Conventional Name	Retained on U.S. Sieve No.	Diameter (mm)
Very coarse sand	#18	1 - 2
Coarse sand	#35	0.5 - 1
Medium sand	#60	0.25 - 0.5
Fine sand	#140	0.10 - 0.25
Very fine sand	#270	0.05 - 0.10
Silt	by hydrometer	0.002 - 0.05
Clay	by hydrometer	Less than 0.002

2. Sandy loams shall conform to USDA Soil Taxonomy definitions and as follows: Soil material that contains either 20 percent clay or less, and the percentage of silt plus twice the percentage of clay exceeds 30 percent, and 52 percent or more sand; or less than 7 percent clay, less than 50 percent silt, and between 43 percent and 52 percent sand.

   a. Coarse sandy loam: 25 percent or more very coarse and coarse sand and less than 50 percent any other grade of sand.
   b. Sandy loam: 30 percent or more very coarse, coarse and medium sand, but less than 25 percent very coarse sand, and less than 30 percent very fine or fine sand.
   c. Fine sandy loam: 30 percent or more fine sand and less than 30 percent very fine sand or between 15 and 30 percent very coarse, coarse, and medium sand.

2.2 SOIL MIX

A. The soil mix for planting trees, shrubs, groundcover, and for seeding and sodded areas shall be imported from an off-site source and be installed at a min of 3” depth for all seeded or sodded areas, and to depths shown on the Contract documents for trees, shrubs, and other plant materials. The soil mix shall be “sandy loam” determined by mechanical analysis (ASTM D 422) and based on the "USDA Classification System" and as defined in this Section. It shall be of uniform composition, without admixture of subsoil. It shall be free of stones greater than one and one-quarter inches, lumps, plants and their roots, debris and other extraneous matter as determined by the Owner’s Representative. Planting soil shall have the following grain size distribution for material passing the #10 sieve:

Millimeter	Percent Passing Maximum	Weight by Minimum
2	--------	100
1	100	80
0.5	87	67

0.25	78	48
0.10	68	30
0.05	55	22
0.002	7	2

B. Maximum size for planting soil mix shall be shall be one quarter inch largest dimension. The maximum retained on the #10 sieve shall be 25% by weight of the total sample.

2.3 SOIL ADDITIVES

A. General: Soil additives shall be used to counteract soil deficiencies as recommended by the soils testing analysis.

B. Acidulant for adjustment of loam pH shall be commercial grade flours of sulfur, ferrous sulfate, or aluminum sulfate that are unadulterated. Acidulants shall be delivered in unopened containers with the name of the manufacturer, material, analysis and net weight appearing on each container.

C. Ground limestone for adjustment of loam pH shall contain not less than 85 percent of total carbonates and shall be ground to such fineness that 40 percent will pass through 100 mesh sieve and 95 percent will pass through a 20 mesh sieve. Contractor shall be aware of loam pH and the amount of lime needed to adjust pH to meet the requirements of the testing lab recommendations.

D. Organic component of the manufactured loam shall be compost and peat moss used in equal proportions. Compost shall be a stable humus-like material produced from the aerobic decomposition of organic residues. The residues, if bio-solids, shall consist of compost meeting MA-DEP Type 1 requirement or approved equal. The residues shall be dark brown or black in color, with no visible free water or dust and no unpleasant odor, meeting the following criteria certified by the producer.

1.	Carbon-nitrogen ratio	Minimum 10:1 maximum 25:1
2.	Stability CO2 evolution test Or Dewar self-heating test Or Woods End Laboratory's Compost Test Kit	<10 mg CO2 - C/g BVS/day <10 degrees C above room temp.
3.	Organic content (Loss	40 percent minimum dry weight on Ignition; minus #10 Sieve, 430 degrees C)
4.	Particle size	90 percent passing 0.5 inch screen, 100 percent passing one inch screen
5.	Inorganic debris	1 percent maximum (dry weight)
6.	pH	minimum 5.5 - maximum 8.0
7.	Soluble Salts	>2 and <4.0 mmhos/cm (ds/m) 8. Density 850-1,050 lb./cy

E. Peat moss shall be composed of the partly decomposed stems and leaves of any of several species of sphagnum moss. It shall be free from wood, decomposed colloidal residue and other foreign matter. It shall have an acidity range of 3.3 pH to 5.5 pH, as determined in accordance

with the methods of testing of A.O.A.C., latest edition. Its water absorbing ability shall be a minimum of 1,100% by weight on an oven-dry basis.

F. Sand, as required for mixing with soil to meet Specification requirements shall be uniformly graded coarse sand consisting of clean, inert, rounded grains of quartz or other durable rock and free from loam or clay, surface coatings, mica, other deleterious materials with the following gradation.

Millimeter	Percent Passing by Weight	
	Maximum	Minimum
5	------	100
2	100	80
1	86	58
0.5	50	18
0.25	24	7
0.10	0	10
0.05	0	4.5
0.002	0	0.3

1. The ratio of the particle size for 70% passing (D70) to the particle size for 20% passing (D20) shall be 4.0 or less. (D70/D20 < 4.0)

G. Bone meal shall be fine ground, steam-cooked, packing house bone with a minimum analysis of 23 percent phosphoric acid and one percent nitrogen.

H. Gypsum ($CaSO_4 \cdot 2H_2O$) shall be agricultural grade, granular form.

I. Gradation shall conform to the following:

Sieve Designation	Percent Passing by Weight
No. 8 (2.36 mm) 100	100
No. 16 (1.18 mm) 97	97
No. 30 (0.60 mm) 82	82
No. 50 (0.30 mm) 46	46
No. 100 (0.15 mm) 21	21

J. Commercial fertilizer shall be a product complying with the State and United States fertilizer laws. Deliver fertilizer to the site in the original unopened containers bearing the manufacturer's certificate of compliance covering analysis and which shall be furnished to the Owner’s Representative. Fertilizer shall contain not less than the percentages of weight of ingredients as recommended by the soil testing analysis.

PART 3 - EXECUTION

3.1 FILLING AND COMPACTION

A. Subgrade shall be prepared for prior to spreading of planting soil mix under Section 312313 - Subgrade Preparation.

B. Perform percolation tests on existing subsoils, or placed fill, prior to placing and spreading planting soil mix:

1. Perform percolation testing of subsoil in planting pits or placed fills to determine whether or not the subgrade will drain properly. Perform percolation tests as specified in this Section and for each lift of loam borrow.
2. In the event that percolation testing indicates that the subsoil, placed fills has been over compacted and will not drain, the Contractor shall loosen up the top 6 inches of the subgrade to be planted by using a hand shovel and loosen to a density that will percolate as specified under the work of this Section.

C. Confirm that the subgrade is at the proper elevation and that no further earthwork is required to bring the subgrade to proper elevations.

D. The Contractor shall install planting soil mix in successive horizontal lifts no thicker than 12 inches in one lift in plant bed areas to the desired depth and compaction as described herein. The Contractor shall install the soil at a higher level to anticipate any reduction of soil volume due to compaction, settling, erosion, decomposition, and other similar processes during the warranty period.

E. In addition to the range cited above, compact each lift sufficiently to reduce settling, but not enough to prevent the movement of water and feeder roots through the soil. The loam borrow in each lift should feel firm to the foot in all areas and make only slight heel prints.

3.2 FINE GRADING/PLACING OF PLANTING SOIL

A. Planting soil shall be sampled and tested as specified to verify application and incorporation any required soil amendments to meet the recommendations of the soil testing analysis. It shall also be adjusted for pH and for organic content as specified in Sections 329300 – Planting, Section 329213 – Seeding, and Section 329223 – Sodding for the Work of those specific Sections.

B. Immediately prior to dumping and spreading planting soil for seeded or sodded areas, the subgrade shall be rototilled to depth of 4 inches to reduce construction compaction and to make sure planting soil bonds to subgrade, raked smooth, and cleaned of all stones greater than 1 inch and all debris or rubbish. Such material shall be removed from the site, not raked to the edges and buried. Notify the Owner’s Representative that the subsoil has been prepared and cleaned and request his/her attendance on site to review and approve subgrade conditions prior to spreading the planting soil. The soil shall be weed free. If weeds occur after planting, the contractor shall be responsible to remove all weeds at no additional cost.

C. Planting soil delivered to the site shall be protected from erosion at all times. Materials shall be spread immediately. Otherwise, materials that set on site for more than 24 hours shall be covered with a tarpaulin, or other soil erosion system acceptable to the Owner's Representative, and surrounded by silt fence to protect the soil from erosion or contamination.

D. No planting soil shall be handled, planted, or seeded or sodded in any way if it is in a wet or frozen condition. A moist soil is desirable.

E. Once the planting soil has been spread, sufficient grade stakes shall be set for checking the finished grades. Stakes must be set in the bottom of swales and at the top of slopes. Deviation from indicated elevations that are greater than one-tenth of a foot shall not be permitted. Connect contours and spot elevations with an even slope. Finish grades shall be smooth and continuous with no abrupt changes at the top or bottom of slopes.

F. During the compaction process, all depressions caused by settlement or rolling shall be filled with additional planting soil and the surface shall be re-graded and rolled until presenting a smooth and even finish corresponding to the required grades.

G. The Contractor shall install planting soil in successive horizontal lifts no thicker than 2 feet in plant bed areas to the desired compaction as described herein. The Contractor shall install the soil at a higher level to anticipate any reduction of soil volume due to compaction, settling, erosion, decomposition, and other similar processes during the warranty period.

1. Compact planting soil to the required density as specified herein.
2. Maximum dry density for planting soil shall be determined in accordance with ASTM D698. The following percentages of minimum to maximum dry densities shall be achieved for fill materials or prepared subgrades.

H. In seeded and sodded areas, plant beds, and tree pits:

1. Minimum: 80 percent.
2. Maximum: 85 percent
3. The surface area of each lift hall shall be scarified by raking prior to placing the next lift.

I. In addition to the range cited above, compact each lift sufficiently to reduce settling, but not enough to prevent the movement of water and feeder roots through the soil. The loam borrow in each lift should feel firm to the foot in all areas and make only slight heel prints. At completion of the planting soil installation, the soil should offer a firm, even resistance when a soil sampling tube is inserted from lift to lift. After the placement of each lift, perform percolation tests to determine if the soil has been over compacted. Perform the following percolation test procedure:

1. Dig a hole in the installed soil that is a minimum of 4 inches in diameter. Holes in 6-inch lift in turf areas shall be 4 inches deep. Holes in 2 foot lifts in plant beds shall be 8 inches deep. Do not penetrate through the lift being tested.
2. Fill the hole with water and let it drain completely. Immediately refill the hole with water and measure the rate of fall in the water level.
3. In the event that the water drains at a rate less than one inch per hour, till the soil to a depth required to break the over compaction.

4. Perform a minimum of one soil percolation test per 10,000 square feet area of turf area and 2,500 square feet of tree and shrub planting area as directed by the Owner's Representative.

J. Select equipment and otherwise phase the installation of the planting soil to ensure that heavy wheeled equipment does not travel over prepared subsoil, or already installed planting soil. Movement of tracked equipment over said soils will be reviewed and considered for approval by the Owner's Representative. If it is determined by the Contractor that wheeled equipment must travel over already installed soil, provide a written description of sequencing of work that ensures that compacted soil is loosened and un-compacted as the work progresses, or place 1 inch thick steel plate ballast (or equivalent ballast approved by the Owner's Representative) over the length and width of any travel way to cover loam borrow to protect it from compaction.

K. Disturbed areas outside the limit of lawn work shall be graded smooth and spread with a minimum of 3 inches of planting soil to the finished grade.

L. Contractor shall be responsible for maintaining all stockpiles of planting soil on the site until final placement.

M. Any excess on-site soil shall be placed in areas as directed by the Owner's Representative, or if directed, removed from the site at no additional cost.

3.3 ACCEPTANCE

A. Confirm that the final grade of the planting soil mix is at the proper finish grade elevations and to the depths shown on the Contract Documents. Adjust grade or depth as required to meet the contours and spot elevations noted on the Plans. Request the presence of the Owner's Representative to inspect final grade before planting, seeding or sodding. Do not proceed with the remaining Work of this Contract until the Owner's Representative has given his/her written approval of the final grades.

END OF SECTION 329113

SECTION 329213 - SEEDING

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. Furnishing and applying hydro-mulch seeding.

B. Watering

C. Site clean-up.

D. Maintenance and guarantee

E. Related Requirements:

1. Section 329113 “Plantings Soils.”
2. Section 312313 “Subgrade Preparation.”
3. Section 328000 “Irrigation.”

1.3 QUALITY ASSURANCE:

A. Seed: The Owner’s Representative shall be furnished a signed copy of statement from vendor, certifying that each container of seed delivered is labeled in accordance with the Federal Seed Act and is at least equal to requirements previously specified. Seed analysis shall be furnished prior to commencement of planting operations. Each lot of seed may be re-sampled and re-tested in accordance with latest Rules and Regulations under the Federal Seed Act at the discretion of the Owner’s Representative. If these tests reveal the seed to be below the specified pure live seed content, the Contractor shall be required to plant additional seed to compensate for the deficiency at no additional cost to the Owner. The seed retests will be conducted by the State Seed Laboratory. Allowance will be made for the actual pure live seed content of the specified grasses in determining the actual planting rate.

B. Make written request for inspection after seeding operations have been completed. Such inspection is for the purpose of establishing the Maintenance Period. Submit written requests for inspections to the Owner’s Representative at least seven (7) days prior to the inspection date.

1.4 SUBMITTALS

A. Furnish required copies of manufacturer's literature, certifications, or laboratory analytical data for the following items:

1. Seed Source. (Certification)
2. Fiber Mulch. (Laboratory Analytical Data)
3. Tank Mix Fertilizer. (Certification or Laboratory Analytical Data)
4. Top-dress Fertilizer. (Certification analysis, and proof of purchase)
5. Erosion Control (sample and manufacturer’s information)

PART 2 - PRODUCTS

2.1 SEED FOR LAWN AREAS

A. Seed for lawn areas shall be Tifway 419 Bermuda Grass. All seed used shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. All seed shall be furnished in sealed standard containers unless exception is granted in writing by the Owner’s Representative. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Seed mixture shall be fresh, clean, new crop seed. Grass shall be of the previous year's crop and in no case shall the weed seed content exceed 0.25% by weight. The seed shall be furnished and delivered in the proportion specified below in new, clean, sealed and properly labeled containers. The minimum percentage by weight of pure live seed in each lot of seed shall be as follows and seed shall be planted at the rate per acre indicated under pure live seed required per acre.

B. Seed for lawn areas to be planted at the rate of 3lbs per 1000 sq. ft.

2.2 SEED FOR NATURAL AREAS

A. Seed for natural areas shall be “Native Trail Mix” as supplied by Native American Seed, 3791 N. US Highway 377, Junction TX. 76849, phone 800.728.4043, www.seedsource.com. All seed used shall be labeled in accordance with U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act. All seed shall be furnished in sealed standard containers unless exception is granted in writing by the Owner’s Representative. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Seed mixture shall be fresh, clean, new crop seed. Grass shall be of the previous year's crop and in no case shall the weed seed content exceed 0.25% by weight. The seed shall be furnished and delivered in the proportion specified below in new, clean, sealed and properly labeled containers. The minimum percentage by weight of pure live seed in each lot of seed shall be as follows and seed shall be planted at the rate per acre indicated under pure live seed required per acre.

1. Common Name

a. Texas Bluebonnet

b. Greenthread
c. Indian Blanket
d. Lanceleaf Coreopsis
e. Purple Coneflower
f. Cutleaf Daisy
g. Pink Evening Primrose
h. Texas Yellow Star
i. Scarelt Sage
j. Huisache Daisy
k. Purple Prairie Clover
l. Indian Paintbrush
m. Standing Cypress
n. Bush Sunflower
o. Golden-Wave
p. Clasping Coneflower
q. Lemon Mint
r. American Basketflower
s. Black-Eyed Susan
t. Mexican Hat
u. Plains Coreopsis
v. Prairie Coneflower
w. Maximilian Sunflower
x. Lazy Daisy
y. Missouri Primrose
z. Buffalograss
aa. Blue Grama
bb. Prairie Wildrye
cc. Little Bluestem
dd. Green Sprangletop
ee. Sand Lovegrass
ff. Sideoats Grama
gg. Cane Bluestem
hh. Texas Cupgrass
ii. Virginia Wildrye
jj. White Tridens

B. Native Trail Mix To be installed at a rate of 1lb per 1000 sq. ft.

C. Weed seed shall not exceed ten (10%) percent by weight of the total of pure live seed and other material in the mixture. Johnson grass, nut grass, or other noxious weed seed will not be allowed

2.3 FERTILIZER

A. Shall be a starter fertilizer as recommended by the seed company the seed is purchased from. The seed shall be uniform in composition, free-flowing, and suitable for application with approved equipment. The fertilizer shall be delivered to the site in bags or other convenient

containers, each fully labeled, conforming to the applicable State fertilizer laws, and bearing the name or trademark and warranty of the producer.

2.4 HERBICIDES, CHEMICALS AND INSECTICIDES

A. Provide chemicals and insecticides as needed for fungus or pest control. All chemicals and insecticides shall be approved by the State of Texas Department of Food and Agriculture for the intended uses and application rates.

B. Provide post emergent weed control throughout the maintenance period to ensure a germinated and mown lawn free of weeds.

2.5 WATER

A. The Contractor shall be responsible to furnish his own supply of water to the site at no extra cost. All work injured or damaged due to the lack of water, or the use of too much water, shall be the Contractor's responsibility to correct. Water shall be free from impurities injurious to vegetation. Water shall be free from oil, acid, alkali, salt, and other substances harmful to growth of grass. The water source shall be subject to approval prior to use.

2.6 FIBER MULCH FOR HYRDROMULCHING (LAWN SEED ONLY)

A. Fiber mulch, for use with the hydraulic application of grass seed and fertilizer, shall consist of specially prepared mulch. It shall be processed in such a manner that it will not contain germination or growth inhibiting factors. It shall be dyed an appropriate color to allow visual metering of its application. The mulch shall have the property of becoming evenly dispersed and suspended when agitated in water. When sprayed uniformly on the surface of the soil, the fibers shall form a blotter-like groundcover which readily absorbs water and allows infiltration to the underlying soil. Weight specifications from suppliers for all applications shall refer only to air dry weight of the fiber, a standard equivalent to eighteen (18%) percent moisture. The mulch material shall be supplied in packages having a gross weight not in excess of 100 pounds and be marked by the manufacturer to show the dry weight content. Suppliers shall be prepared to certify that laboratory and field testing of their product has been accomplished and that it meets all of the foregoing requirements.

2.7 SLURRY MIX COMPONENTS FOR HYDROMULCHING (PER ACRE FOR LAWN SEED)

A. The slurry mix for lawn seed shall be composed of:

1.	Fiber Mulch	2,000 Pounds
2.	Grass Seed	130 lbs
3.	Fertilizer	Starter Fertilizer – amount recommended by Manufacturer

B. Hydromulch shall not be used to seed the native seed mix.

2.8 EROSION CONTROL MATTING

A. Erosion control matting for covering hydromulch areas with slopes steeper than or equal to three to one (3:1) shall be a bonded fiber matrix. The bonded fiber matrix shall be a hydraulically applied product that upon drying shall adhere to the soil in the form of a continuous 100% coverage, biodegradable erosion control blanket. The bonded fiber matrix shall be comprised of long strand wood fibers held together by a bonding agent that, upon drying, becomes insoluble and non-dispersible.

B. The bonded fiber matrix shall meet the following requirements. The binder shall not dissolve or disperse upon re-wetting. The matrix shall have no holes greater than 0.04 inch (1mm) in size. The matrix shall have no gaps between product and soil. The matrix shall have water-holding capacity of 1.2 gallons per pound of matrix (1000g/100g). The matrix shall have no germination or growth inhibiting factors and shall not form a water insensitive crust. The matrix shall be composed of materials that are 100% biodegradable and are beneficial to plant growth.

PART 3 - EXECUTION

3.1 HYDROMULCH SEEDING FOR LAWN AREAS:

A. Bed Preparation: Immediately after the existing soils have been modified per Section: 329113, Planting Soils, and the finished grades have been approved, begin hydro-seeding operation to reduce excessive weed growth.

B. Special Mulching Equipment and Procedures: Hydraulic equipment used for the application of fertilizer, seed, and slurry of prepared wood fiber mulch shall have a built-in agitation system with an operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing up to forty (40) pounds of fiber plus a combined total of seventy (70) pounds of fertilizer solids for each one hundred (100) gallons of water. See mix components mix ration herein this Section. The slurry distribution lines shall be large enough to prevent stoppage. The discharge line shall be equipped with a set of hydraulic spray nozzles which provide even distribution of the slurry on the slopes to be seeded. The slurry tank shall have a minimum capacity of eight hundred (800) gallons and shall be mounted on a traveling unit which may be either self-propelled or drawn with a separate unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution without waste. The Owner's Representative may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

C. Mixing: Care shall be taken that the slurry preparation takes place on the site of the work. The slurry preparation should begin by adding water to the tank when the engine is at half throttle. When the water level has reached the height of the agitator shaft, good recirculation shall be established and seed shall be added. Fertilizer shall then be added, followed by wood pulp mulch. The wood pulp mulch shall only be added to the mixture after the seed and when the tank is at least one-third filled with water. The engine throttle shall be opened to full speed when the tank is half filled with water. All the wood pulp mulch shall be added by the time the tank is two-thirds to three-fourths full. Spraying shall commence immediately when the tank is

full. The operator shall spry the area with a uniform, visible coat by using the green color of the wood pulp as a guide.

D. Application:

1. Contractor shall obtain approval of hydro-mulch area preparation form the Owner's Representative prior to application.
2. Operators of hydro-mulching equipment shall be thoroughly experienced in this type of application. Apply specified slurry mix in a motion to form a uniform mat at specified rate.
3. Keep hydro-mulch within areas designated and keep from contact with other plant material.
4. Slurry mixture which has not been applied within four (4) hours of mixing shall not be used and shall be removed from the site.
5. After application, the Contractor shall not operate any equipment over the covered area.
6. Immediately after application, thoroughly wash off any plant material, planting areas, or paved areas not intended to receive slurry mix. Keep all paved and planting areas clean during maintenance operations.
7. Refer also to the maintenance portion of this Section.

E. Unseeded Areas: If, in the opinion of the Owner's Representative, unplanted skips and areas are noted after hydro-mulching, the Contractor shall be required to seed the unplanted areas with the grasses that were to have been planted at no additional cost to the Owner.

F. Limit of grading and earthwork shall be limit of seeding unless otherwise indicated on the Contract Documents. All areas disturbed outside the limit of grading shall be prepared and seeded as specified herein at no additional cost.

G. The season for seeding shall be from April 1 to August 30. The actual planting of seed shall be done, however, only during periods within this season which are normal for such work as determined by weather conditions and by accepted practice in this locality. To prevent loss of soil via water and wind erosion and to prevent the flow of sediment, fertilizer, and pesticides onto roadways, sidewalks, and into catch basins, seed loam areas within 5 Days of spreading the loam.

H. Seed only when the bed is in a friable condition, not muddy or hard.

3.2 SEEDING FOR NATURAL AREAS

A. Seeding for natural areas using the Native Seed Mix shall be done according to the supplier's (Native American Seed) recommendations. The area to be seeded shall be weed free, with a smooth raked soil. Seed shall be drilled into the soil no deeper than ¼ inch in depth and then rolled. Plant only when soil temperatures are 65 degrees or higher. The Contractor shall be responsible to discuss the planting techniques and timing with the seed supplier and follow their recommendations. Failure to comply with seed supplier recommendations and resulting failure of seed to take properly and germinate shall be grounds for rejection of the seeding by the Owner's Representative. If the seed doesn't germinate properly the Contractor shall be

responsible to re-prepare and reseed the site at no additional cost to the Owner until a satisfactory germinating can be achieved.

3.3 EROSION CONTROL MATTING

A. Erosion control matting of heavy jute mesh shall be installed immediately after hydro-seeding and hydro-mulching in the areas designated on the Contract Documents, on slopes three to one (3:1) or steeper, within surface drainage swales, and around surface drains. Matting installation shall follow written acceptance of fine grading by Owner's Representative.

B. Matting shall be installed perpendicular to slopes, and shall extend at least 3 feet beyond slope crest. Fibers shall be placed in contact with the soil for the entire length of the mat. Provide check slot at top of slope and anchor slot at bottom of slope where indicated.

C. Roll out the matting perpendicular to the slope. Do not stretch the fabric. In drainage swales, center the fabric along the flow line. Install the matting in a check slot at the top and bottom of the slope of the area to be covered. Check slots shall be 6 inches deep and 6 inches wide. Fabric shall extend down one wall of the check slot and across the full width of the base. Overlap edges of matting rolls 4 inches minimum and overlap the ends 18 inches at a minimum.

D. Install staples in check slots, edges, center and ends of rolls by driving specified steel staples 2 feet on center over the entire area to be covered, except at check slots and ends of rolls, where staples shall be placed 6 inches on center.

E. Fill check slots with loam and tamp firmly.

F. Following matting installation, roll the entire area with a smooth drum roller weighing between 50 and 75 pounds per linear foot of roller. The finished installation of matting shall be firmly in contact with the soil and provide a smooth, finished appearance free from lumps or depressions.

3.4 LAWN MAINTENANCE

A. Maintenance shall begin immediately after any area is seeded and shall continue for a 60 day active growing period following the completion of all lawn construction work, and or until final acceptance of the project.

B. Maintenance shall include reseeding, mowing, watering, weeding, and fertilizing a second time at the end of the 60 day period in addition to the fertilizer incorporated in the original hydro-seeding mix. Lawn work maintenance shall also include chemical treatments as required for fungus and/or pest control.

C. During the maintenance period, any decline in the condition of seeded areas shall require immediate action to identify potential problems and to undertake corrective measures.

D. D.Watering shall be done in a manner that will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall use the irrigation system to water

unless it is inoperative at which time the Contractor shall supply his own source of water and equipment to accomplish proper watering.

1. The Contractor shall provide all labor and arrange for all watering necessary to establish an acceptable lawn. In the absence of adequate rainfall, watering shall be performed daily or as often as necessary to maintain moist soil to a depth of at least 2 inches for seeded. At no time shall a tank truck be allowed on the seeded beds.
2. Watering shall be done in a manner that will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply water to the required soil depths each 8-hour period.

E. Protection

1. Lawn areas shall be protected by a 3-foot high barrier constructed of 2 inch by 2 inch hardwood stakes or iron pipes set 18 inches in the ground at 10 foot intervals and connected by No. 10 wire. Flags of white cloth shall be secured to the wire at center points between stakes.
2. Barriers must be raised immediately after lawn construction and shall be maintained until Acceptance.

F. After the grass in seeded areas has germinated, reseed all areas and parts of areas that fail to show a uniform stand of grass. Reseed such areas and parts of areas repeatedly until all areas are covered with a satisfactory growth of grass with no bare spots showing. Reseeding together with necessary grading, fertilizing, and trimming shall be done at the Contractor's expense.

G. Mowing and Edging:

1. The Contractor shall keep lawn areas mowed until Acceptance of the contract by cutting to a height of 2 inches when growth reaches 3 inches or as directed by the Owner's Representative.
2. At each mowing, all edges of walks, drives, plant beds and other border conditions shall be edge trimmed by hand or machine to produce straight and uniform edge conditions.
3. Remove and discard from paved areas only clippings and debris generated by each mowing and edging operation legally off-site. Do not mow grass when wet.

H. Fertilizing: The first application of fertilizer is specified, provided, performed and paid for under the hydro-seeding mix. A second application of fertilizer shall be applied to seeded areas at the end of the 60 day period. This second application shall be applied at a rate recommended by the manufacturer per 1,000 square feet.

3.5 NATIVE SEED MIX MAINTENANCE

A. Areas planted with the Native Seed Mix shall not be mowed. They shall be watered to insure that the seeded area is kept moist until the seed has germinated to about 1 inch tall. After that point it shall be watered 3 times per week until acceptance.

3.6 INSPECTIONS:

A. Make written request for inspection prior to seeding and after areas have been seeded.

B. Submit requests for inspections to Owner’s Representative at least two (2) days prior to the anticipated inspection date.

3.7 FINAL ACCEPTANCE:

A. The seeded areas will be reviewed and accepted by the Owner’s Representative upon Final Completion of the Work, but exclusive of re-application under the Guarantee Period.

B. Final Acceptance of lawn establishment shall be Ninety five (95%) percent uniform coverage of grass in excess of one 1"0 inch height. No bare spots of greater than three (3) inches will be accepted. Upon Final Acceptance, the Owner will assume the responsibility for maintenance of the work.

C. If seeded areas are deficient, the Contractor's responsibility for maintenance of all seeded areas shall be extended until deficiencies are corrected. Seeded areas to be corrected shall be prepared and re-seeded in accordance with the requirements of this Section.

D. Owner’s Representative's inspection shall determine whether maintenance shall continue in any part.

3.8 CLEAN UP

A. Keep all areas of work clean, neat, and orderly at all times. Keep all paved areas clean during lawn installation operations. Clean up and remove all deleterious materials and debris from the entire work area prior to Final Acceptance to the satisfaction of Owner’s Representative.

END OF SECTION 329213

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SECTION 329223 - SODDING

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. Furnishing and laying sod.

B. Watering

C. Site clean-up.

D. Maintenance and guarantee

E. Related Requirements:

1. Section 329113 – “Planting Soil.”
2. Section 328000 – “Irrigation.”
3. Section 312313 – “Subgrade Preparation.”

1.3 SUBMITTALS

A. All delivery receipts and copies of invoices for materials used for this Work shall be subject to verification by the Owner’s Representative.

B. Submit a producer's specification and a quart sample of the compost proposed for the Owner’s Representative's approval

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Sod: Harvesting and planting operations shall be coordinated with not more than forty eight hours elapsing between the harvesting and planting.

B. Fertilizer:

1. Unopened bags labeled with the analysis.
2. Conform to Texas Fertilizer Law.

1.5 QUALITY CONTROL

A. The Contractor who plants the sod is responsible for supervision of his crew, while planting the sod and maintaining the sod until the entire project is accepted by the Owner.

PART 2 - PRODUCTS

2.1 SOD

A. The sod shall be TIF 419 Bermuda Grass and shall consist of stolons, leaf blades, rhizomes and roots with a healthy, virile system of dense, thickly matted roots throughout the soil of the sod for a thickness not less than one inch. Sod shall be alive, healthy and vigorous and shall be free of insects, disease, stones and undesirable foreign materials and grasses. Sod shall have been produced on growing beds of clay or clay-loam topsoil. The sod shall not be harvested or planted when its moisture condition is so excessively wet or dry that its survival will be affected. If sod is stacked, it shall be kept moist and shall be stacked roots-to-roots and grass-to-grass.

B. The sod shall be cut in strips four feet wide, or as called for on plan, to be laid parallel with the contours.

2.2 FERTILIZER

A. All fertilizer shall be delivered in bags or containers clearly labeled showing the analysis.

B. All fertilizer shall be in acceptable condition for distribution and shall be applied uniformly over the planted area two weeks after sodding.

C. All fertilizer shall have an analysis of 3-1-2 or as recommended for this project location and soils. The fertilizer rate shall be 45 pounds of nitrogen per acre.

2.3 WATER

A. The water shall be furnished by the Contractor and shall be clean and free of industrial wastes or other substances harmful to the germination of the seed or to the growth of the vegetation. The amount of water will vary according to the weather variables. Generally, the sod should be soaked one time per day for three weeks or until established. Soaking is mandatory after spreading the fertilizer.

PART 3 - EXECUTION

3.1 GENERAL

A. All turf operations are to be executed across the slope, parallel to finished grade contours.

3.2 SOIL PREPARATION

A. Prepare subgrade and place planting soil for sodded areas prior to sodding as specified in Section 329113, “Planting Soils.”

B. Cleaning: Soil shall be further prepared by the removal of any debris, building materials, rubbish, weeds and stones prior to placing any sod.

3.3 LAYING SOD

A. Prior to laying the sod, planting soil shall be raked smooth to true grade and moistened to a depth of four inches, but not to the extent causing puddles. The sod shall be laid smoothly, tightly butted edge to edge, and with staggered joints. The sod shall be pressed firmly into the sod bed by mechanical roller so as to eliminate all air pockets, provide a true and even surface, and insure knitting without displacement of the sod or deformation of the surfaces of sodded areas. Following compaction, compost shall be used to fill all cracks between sods. Excess compost shall be worked into the grass with suitable equipment and shall be well watered. The quantity of compost shall be such that it will cause no smothering or burning of the grass.

3.4 LAWN MAINTENANCE

A. Maintenance shall begin immediately after any area is sodded and shall continue for a minimum 60 day active growing period following the completion of all lawn construction work, and or until final acceptance of the project.

B. Maintenance shall include re-sodding, mowing, watering, weeding, and fertilizing a second time at the end of the 60 day period. Lawn work maintenance shall also include chemical treatments as required for fungus and/or pest control.

C. During the maintenance period, any decline in the condition of sodded areas shall require immediate action to identify potential problems and to undertake corrective measures.

D. Watering shall be done in a manner that will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall use the irrigation system to water unless it is inoperative at which time the Contractor shall supply his own source of water and equipment to accomplish proper watering.

1. Watering shall be done in a manner that will provide uniform coverage, prevent erosion due to application of excessive quantities over small areas, and prevent damage to the finished surface by the watering equipment. The Contractor shall furnish sufficient watering equipment to apply water to make sure the sod is green and growing at all times. If sod turns brown due to lack of water it shall be removed and replaced at no cost to Owner.

E. Mowing and Edging:

1. The Contractor shall keep lawn areas mowed until Acceptance of the project by cutting to a height of 2 inches when growth reaches 3 inches, or as directed by the Owner's Representative.
2. At each mowing, all edges of walks, drives, plant beds and other border conditions shall be edge trimmed by hand or machine to produce straight and uniform edge conditions.
3. Remove and discard from paved areas clippings and debris generated by each mowing and edging operation legally off-site. Do not mow grass when wet.

F. Fertilizing: The first application of fertilizer shall be as recommended by the Soil Lab used to test the new planting soil. A second application of fertilizer shall be applied to sodded areas at 60 days later. This second application shall be applied at a rate recommended by the manufacturer per 1,000 square feet.

3.5 INSPECTIONS:

A. Make written request for inspection prior to sodding and after areas have been sodded.

B. Submit requests for inspections to Owner's Representative at least two (2) days prior to the anticipated inspection date.

3.6 FINAL ACCEPTANCE:

A. The sodded areas will be reviewed and accepted by the Owner's Representative upon Final Completion of the Work, but exclusive of re-working under the Guarantee Period.

B. Final Acceptance of lawn establishment shall be Ninety five (95%) percent uniform coverage of grass in excess of one 1"0 inch height. No bare spots of greater than three (3) inches will be accepted. Upon Final Acceptance of the project, the Owner will assume the responsibility for maintenance of the lawns.

C. If sodded areas are deficient, the Contractor's responsibility for maintenance of all sodded areas shall be extended until deficiencies are corrected. Sodded areas to be corrected shall be prepared and re-sodded in accordance with the requirements of this Section.

D. Owner's Representative's inspection shall determine whether maintenance shall continue in any part.

3.7 CLEAN UP

A. Keep all areas of work clean, neat, and orderly at all times. Keep all paved areas clean during lawn installation operations. Clean up and remove all deleterious materials and debris from the entire work area prior to Final Acceptance to the satisfaction of Owner's Representative.

END OF SECTION 329223

SECTION 329300 - PLANTING

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. Planting trees, shrubs, and ground cover
2. Planting maintenance.
3. A two year guarantee period for all plants.
4. Providing and placing planting soil mix.
5. Tree Staking

B. Related Requirements:

1. Section 312000 "Earth Moving" for preparation, compaction, and grading of granular base.

1.3 SUBMITTALS

A. At least 30 days prior to the first day of the planting season described in this Section: PLANTING, submit to the Owner’s Representative proof of certification of Foreman or Crew Leader as a Certified Landscape Professional or Certified Horticulturist.

B. At least 30 days prior to ordering materials, the Contractor shall submit to the Owner’s Representative, samples, certifications, manufacturer's product data and certified test results for materials as specified below. No materials shall be ordered or delivered until the required submittals have been reviewed and approved by the Owner’s Representative. Delivered materials shall closely match the approved samples. Approval shall not constitute final acceptance. The Owner’s Representative reserves the right to reject, on or after delivery, any material which does not meet these Specifications.

C. Material Sampling and Testing:

D. Planting Mulch: Submit a one cubic foot sample.

E. Antidesiccant: Submit manufacturer's product data.

F. Peat: Submit a one cubic foot sample and manufacturer's certification of contents.

G. Mycorrhizal Fungal Inoculant:

H. Submit manufacturer's product data certifying that inoculant being supplied conforms to these Specifications.

I. Submit the purchasing receipt showing the total quantity purchased for the Project prior to installation.

J. Submit empty packets of fungal spore inoculant to the Owner’s Representative for verification of use.

K. Aluminum Edging: Submit manufacturer's product data.

L. Tree Stakes

1.4 EXAMINATION OF CONDITIONS

A. All areas to be planted shall be inspected by the Contractor before starting Work, and any defects such as incorrect grading or inadequate drainage shall be reported to the Owner’s Representative prior to beginning this Work.

B. The Contractor shall be solely responsible for judging the full extent of Work requirements involved, including but not limited to the potential need for storing and maintaining plants temporarily and/or re-handling plants prior to final installation.

C. All plants are the full responsibility of the Contractor between the time of digging at the nursery and final acceptance.

1.5 QUALITY ASSURANCE

A. A.Qualification of Landscape Contractor: The Work of this Section: PLANTING, shall be performed by a landscape contracting firm which has successfully installed Work of a similar quality, schedule requirements, and construction detailing with a minimum of five years experience. Proof of this experience shall be submitted to the Owner’s Representative.

B. Qualification of Arborist: All Work of pruning shall be performed by an arborist certified by the American Arborist Association or the International Society of Arboriculture and be licensed in Texas.

C. Pest Control Applicator: Texas-Licensed landscape pest control applicator.

D. Comply with American Joint Committee of Horticultural Nomenclature "Standardized Plant Names", American Association of Nurserymen, Inc. American Standard for Nursery Stock.

E. Provide plant material as shown on Contract Documents. Plants shall be subject to inspection and approval by Owner’s Representative at place of growth or upon delivery to site for conformity to specified requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Delivery:

1. Pack plant material to protect against climatic, seasonal, and breakage injuries during transit.
2. Securely cover plant tops with tarpaulin or canvas to minimize wind-whipping and drying. Use antidesiccant upon approval of Owner's Representative.
3. Pack and ventilate to prevent sweating of plants during transit by rail. Ensure prompt delivery and careful handling to point of delivery at planting job site.

B. Delivery:

1. Fertilizer and Soil Amendments: Original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trademark and conformance to State law.
2. Plants: Provide legible identification labels. Minimum one plant of each species delivered to site shall have identification tag. Do not remove tag until after final inspection.
3. Prevent damage to root ball or desiccation of leaves.
4. Notify Owner's Representative 10 days in advance of delivery.
5. Soil Supplements: Original, unopened and unbroken packages.

C. Inspect trees, shrubs, and ground cover plants for injury, insect infestation, and trees and shrubs for improper size and shape. Owner's Representative shall reject any plant material that has been damaged or is not acceptable to Owner and shall be replaced by acceptable material at no additional cost to Owner.

D. Storage:

1. Protect roots of plant material from drying or other possible injury with soil or acceptable material.
2. Store plant material in area which is shaded and protected from hot weather.
3. Maintain and protect plant material (not to be planted immediately upon delivery) in healthy, vigorous condition.

E. Handling:

1. Do not drop plants.
2. Do not pick up container or balled plants by stem or trunks.
3. Lift and handle balled plants from bottom of ball.
4. If tree balls or bark on trunks is damaged during handling they will be subject to rejection by the Owner and Contractor shall remove and replace at no additional cost to Owner.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install plant life when ambient temperatures may drop below 35 degrees F (2 degrees C) or rise above 95 degrees F (32 degrees C).

B. Do not install plant life when wind velocity exceeds 30 mph (48 k/hr).

1.8 WARRANTY

A. Contractor shall maintain all landscape areas in a healthy, vigorous, and attractive growing condition for a period of 90 days after Final Acceptance.

B. Warrant plant materials to be in healthy, vigorous and attractive growing condition for period of 1 year after Final Acceptance.

C. Replace plants which die, become diseased or unhealthy, or are otherwise found to be in poor condition, as determined by Owner's Representative.

D. Warranty will not apply to damage or injury to plant materials caused by vandalism, vehicles, and storms.

E. Replace plants within 15 days of written notification by Owner's Representative or Owner.

1.9 TREE TAGGING

A. A.Contractor shall pay for all travel expenses of the Owner's Representative related to the tagging of trees at the nursery.

PART 2 - PRODUCTS

2.1 PLANTING SOIL MIX

A. Planting soil mix shall be specified, provided, installed, and paid for.

B. The planting soil mix shall be an approved loam borrow which has been pH adjusted according to particular planting applications and improved through the addition of organic matter as directed below. Planting soil for trees, shrubs, and groundcovers shall conform to the following pH levels:

1. For broad-leaved evergreens and plants of the Heath Family, Ericaceae, requiring an acid soil, planting soil mix shall have a true pH of 4.5 to 5.5. Planting soil mix shall be amended by the Contractor at his own expense to the proper pH range by mixing with sulfur as specified, provided, installed and paid for under Section: Planting Soils, of this Specification. Plants belonging to the Heath Family include but are not limited to the following genuses: Arctostaphylos, Calluna, Chamaedaphne, Enkianthus, Epigaea, Erica, Gaultheria, Gaylussacia, Kalmia, Oxydendron, Pieris, Rhododendron, Vaccinium, and Zenobia.
2. Planting soil mix for general planting of non-acid loving plants shall have a true pH value of 6.0 to 6.5. Planting soil mix shall be amended by the Contractor at his own expense to the proper pH range by mixing with dolomitic limestone as specified, provided, installed and paid for under Section: Planting Soils.

3. The amount of either sulfur or limestone required to adjust the planting soil mix to the proper pH range shall be approved by the Owner's Representative on the basis of soil tests as specified, provided, installed and paid for under the Section: Planting Soils.
4. Planting soil mix for use in groundcover, perennial, and bulb planting shall consist of pH adjusted loam which has been thoroughly premixed with organic material in the proportions of one part organic matter (humus or peat), with 5 parts of approved loam. Organic material shall be specified, provided, installed and paid for under Section: Planting Soils.
5. Presence of vegetative parts of Bermuda grass, Johnson grass, nut grass (Cyperus rotundus), and other hard to eradicate weeds or grass, will be cause for rejection of the topsoil.

2.2 SOIL ADDITIVES

A. A.Soil additives necessary to amend the soil shall be specified, provided, installed and paid for.

2.3 GRADES AND STANDARDS OF PLANTS

A. The Contractor shall furnish all plants shown on the Contract Documents, as specified, and in quantities listed on the PLANT LIST. No substitutions will be permitted, without written approval by the Owner's Representative. All plants shall be nursery grown unless specifically authorized to be collected as noted on the PLANT LIST.

B. All plants shall be typical of their species or variety and shall have a normal habit of growth and be legibly tagged with the proper name. Only plant stock grown within Hardiness Zones 7a through 8a, as established by the USDA Plant Hardiness Zone Map, latest edition, will be accepted.

C. Plants shall be in accordance with ASNS Standards of the American Association of Nurserymen except as noted in this Section. Botanical plant names shall be in accordance with plant designations included in Hortus III.

D. If, at any time during the performance of the Contract, any plant shows signs of graft incompatibility, as determined by the Owner's Representative, then the tree or shrub and all other similarly grafted plants of the same Genus/Species/Variety shall be rejected and removed from the site. Visual symptoms of graft incompatibility as cause for rejection include:

1. Development of over-growths by rootstock or scion resulting in the development of shoulders or inverted shoulders.
2. Suckering of the rootstock combined with poor growth or dieback of scion.
3. Any mechanical weakness between scion and rootstock.
4. Any marked difference in bark pattern and structure between scion and rootstock.
5. Size and shape of plants shall correspond with that normally expected for species and variety of commercially available nursery stock or as shown on Drawings. Overall shape and minimum acceptable size of plants measured before pruning with branches in normal position shall conform to AAN standards. Plants larger in size than specified may be used with approval of Owner's Representative, at no additional cost to Owner. If use of

larger plants is approved, ball of earth or spread of roots for each plant will be increased proportionately.

6. Plant material shall be true to botanical and common name and variety.

E. All deciduous trees shall meet the following standards:

1. Trees shall have a single, straight trunk, well formed, and sturdy. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. Root systems shall be vigorous and fibrous, and not root or pot-bound.
2. Trees with multiple leaders shall conform to all standards noted in this Section for single leader trees and shall be accepted only as noted on the PLANT LIST.
3. All pruning wounds shall show vigorous bark on all edges at the time of harvest. Trees shall be free from all signs of pest and disease damage. The trunk shall be free from sun scald, frost cracks, and wounds resulting from abrasions, fire, animal damage, or other causes.
4. Pruning scars within the crown of any tree shall be clean cut and shall leave no protrusion beyond the branch collar.
5. All trees shall have healthy, vigorous leaves or needles of normal size, color, shape, and texture for the particular species and variety.
6. Deciduous shade trees and deciduous flowering trees shall have fall color typical for their species and variety.
7. Unless otherwise indicated on the PLANT LIST, the height and spread of deciduous shade trees shall be the minimum requirements.
8. Take caliper measurements for deciduous trees 6 inches above ground level up to, and including, 4 inches caliper size and 12 inches above ground for larger sizes.
9. No deciduous tree shall be pruned after the Owner's Representative has tagged the plant in the nursery except as directed by the Owner's Representative.
10. Unless otherwise noted on the PLANT LIST, shade trees for use in paved areas shall have no branches lower than 6.5 feet from finish grade and no higher than 7.5 feet from finish grade. Flowering trees for use in areas away from pedestrian traffic shall have the first branch of their crowns no higher than 4 feet from finish grade.
11. Branching of all deciduous trees shall be best quality representatives of the species, cultivar or variety with lateral branching around the entire trunk to form a symmetrical tree for 80 percent to 100 percent of the tree's outer perimeter. All branches on deciduous trees shall meet the trunk at angles no less than 30 degrees and no greater than 90 degrees from the vertical.
12. All trees shall be container grown. Ball and Burlap not permitted.

F. Evergreen trees shall meet the following standards:

1. The height of the evergreen trees (measured from the trunk flair at the natural ground line of the tree to the midpoint of the terminal leader) shall be not less than the minimum size designated on the PLANT LIST.
2. No trees with double-leaders or twin-heads will be permitted.
3. Evergreen trees shall be of specified height with spread in proportion to height, as designated in ASNS Standards, and shall be well-branched to the ground.
4. All pruning wounds shall show vigorous bark on all edges at the time of harvest.
5. Terminal and top whorl buds of all evergreen trees shall be in healthy and whole condition at the time of harvest.

6. No evergreen tree shall be pruned after the Owner's Representative has tagged the tree in the nursery except as directed by the Owner's Representative.
7. All trees shall have healthy, vigorous leaves or needles of normal size, color, shape, and texture for the particular species and variety.
8. All trees shall be container grown. Ball and Burlap not permitted.

G. All shrubs shall meet the following standards:

1. All shrubs shall be healthy and vigorous plants which are very well shaped, heavily branched, densely foliated, and true to form for the variety.
2. Canes or Trunk(s) and Branches:

    a. Well formed and sturdy.
    b. Branching shall be uniformly distributed close to the ground.
    c. Scars shall be free of rot and not exceed 1/4 the diameter of the wood beneath in greatest dimension unless completely healed (except pruning scars).
    d. Pruning scars shall be clean cut and shall leave little or no protrusion from the trunk or branch.
    e. Graft unions shall be completely healed.
    f. No suckers or water sprouts.
    g. Contain no dead wood.
    h. Free of cracks, splits, or cambium peeling.

3. No shrub with pest or mechanical damage will be accepted.
4. Shrubs shall show no signs of frost or winter damage to the foliage. Foliage shall not be in a state of drought stress. Leaves or needles shall show no signs of wilt or desiccation due to weather stress at any season of the year.

H. All ground cover plants and vines shall meet the following standards:

1. Ground cover plants and vines shall be of size, pot size, age, and condition listed in the PLANT LIST. When indicated on the PLANT LIST, the number of runners and the lengths of the runners of vines shall be minimums.
2. Plants shall be healthy, free of insects, and diseases.

2.4 ROOT SYSTEMS FOR ALL PLANTS

A. Each plant shall have an extensive, symmetrically balanced fibrous root system. Any root ball which shows signs of asymmetry, girdling, injury, or damage to the root system shall be rejected.

B. Curling or spiraling of the roots along the walls of rigid containers will not be accepted. Curling, spiraling or girdling roots within balled and burlapped material will not be accepted.

C. All parts of the fibrous root system of all plants shall be moist and fresh with a white color when washed of soil. When the plant is removed from the container, the visible root mass shall be healthy with white root tips. The root systems of all plants shall be free of disease, insect pests, eggs, or larvae.

D. The diameter and depth of the balls of earth must encompass the fibrous and root feeding system necessary for the healthy recovery of the plant. Minimum root ball diameters and depths shall be in accordance with ASNS standards.

E. No plants shall be loose in the container.

F. Container grown plants which have roots growing out of the container will be rejected.

2.5 MYCORRHIZAL FUNGAL INOCULANT

A. Mycorrhizal fungal inoculant shall be live spores packaged in plastic packets. At a minimum each packet of inoculant shall contain the following:

1. Live spores of VA Endomycorrhizal fungi: Vesicular-Arbuscular mycorrihizae fungi, minimum of 8 species.
2. Live spores of Ectomycorrhizal fungi: including Pisolithus tinctorius.

B. Mycorrhizal fungal inoculant shall be manufactured by one of the following: Plant Health Care Incorporated, 440 William Pitt Way, Pittsburgh, PA 15238, telephone: (800) 421-9051; Horticultural Alliance, 2946 Louise Street, Sarasota, FL 34237, (800) 628-6373; BioPlex Organics, 2213 Huber Drive, Manheim, PA 17545 (800) 441-3573, or an approved equal.

2.6 MULCH

A. Mulch shall be high quality, double-ground, premium cedar or hardwood mulch. It shall not be dyed red or black, but shall be a natural brown color. Mulch shall have been aged for a minimum of six months and not longer than two years. Mulch shall be shredded to a uniform size; free of dirt, debris and foreign matter; with pieces no thicker than 1/4 in. Mulch must be free of stringy material or chunks over 3 inches in size and shall not contain, in the judgment of the Owner’s Representative, an excess of fine particles. Submit sample for the Owner’s Representative's approval.

B. Geotextile fabric for weed control, if called for on the Contract Documents, shall be of woven, non-woven, spun-bonded, or needle-punched construction; composed of polyethylene, polypropylene, or polyester materials.

1. Geotextile fabric shall have porosity of not greater than 5 percent open.
2. Geotextile shall be Weed-X by Dalen Products, Knoxville, TN; DeWitt Pro 5 by the DeWitt Company, Sikeston, MO; or approved equal.

2.7 WATER

A. The Contractor shall responsible to furnish his own supply of water to the site at no additional cost to the Owner. Contractor shall be responsible to furnish adequate supplies at his own cost.

2.8 ANTIDESICCANTS

A. Antidesiccants shall be emulsions or other materials which will provide a protective film over plant surfaces permeable enough to permit transpiration and specifically manufactured for that purpose. Manufacturer of antidesiccant shall be subject to the Owner's Representative's approval and shall be used only after approval by the Owner's Representative. Antidesiccant shall be delivered in containers of the manufacturer and shall be mixed and applied according to the Manufacturer's instructions.

B. Tree stakes shall be Root Anchor as supplied by Tree Stake Solutions, Richmond TX, www.treestakesoulutions.com, 281.617.4235

C. Metal Edging shall be 3/16 inch by 4 inch aluminum edging model Proslide as manufactured by Permaloc, 616.399.9600, permaloc.com. or approved equal.

PART 3 - EXECUTION

3.1 PLANTING

A. Furnishing and planting of plant material shall include, but shall not be limited to, the digging of planting pits and plant beds, amendment of loam as required to produce planting soil mix, provision of soil additives required to adjust for pH requirements of specific plants, furnishing the plants as specified as well as the labor of planting, fertilizing, and maintenance.

B. Prior to spreading of loam, subgrades shall have been tested to determine if they are too compact to drain water as specified, performed and paid for under the Work of Section: Planting Soils.

C. The Contractor shall locate plant material sources and ensure that plants are shipped in timely fashion for installation.

D. Contractor shall locate all existing underground utilities that are within 10 feet of the proposed planting pits and notify the Owner's Representative of any conflicts prior to digging plant pits.

E. Seasons for Planting:

1. Spring: March 15 through June 15
2. Fall: September 1 through November 1

F. Plant Material Inspection:

1. At least one month prior to the expected planting date, the Contractor shall request that the Owner's Representative provide a representative to select and tag stock to be planted under this Section: PLANTING. The Contractor shall pay for the transportation, subsistence and overnight accommodations, if necessary, for the Owner's Representative's representative during the period of time required to select and tag the plant material.

2. The Contractor shall be responsible to certify the availability of quality plants in specified sizes from his/her sources of supply prior to requesting that the Owner's Representative make plant source inspections. In the event that plants at the inspection location are found to be unavailable, insufficient size, or of unacceptable quality, the Contractor shall be liable to reimburse the Owner for all costs of the Owner's Representative's hourly services which are incurred during unproductive inspection trips.
3. Unless specifically designated otherwise, a representative of the Contractor shall accompany the Owner's Representative on all plant material selection field trips.
4. All trees for the Project shall be individually tagged for approval with the Owner's Representative's seals, and no trees shall be accepted for delivery to the site without such seals. Representative samples only of shrubs and ground cover plants may be tagged or marked for approval as an "Approved Typical Sample" and shipped to the site. Any shrub or groundcover plant that arrives at the construction site that does not meet the Approved Typical Sample will be rejected by the Owner's Representative.
5. Plants to be inspected shall be in locations and conditions that allow direct and un-obscured inspection by the Owner's Representative. Container grown or balled and burlapped shrubs shall be pulled from holding blocks by the nurseryman for scrutiny by the Owner's Representative at no additional cost to the Owner. Trees held in storage shall not have branches tied up. Trees shall not have trunks obscured by burlap, cardboard trunk protection, or other devices that would otherwise obscure inspection. In the event that branches are tied up, trunks are obscured by burlap or cardboard trunk protection, or the Owner's Representative cannot inspect root flares, trunks or branching habit, the Contractor shall bear all responsibility and costs associated with tree rejection at a later date during the course of the Contract.
6. Inspection and approval of plants at the source shall not impair the right of subsequent inspection and rejection upon delivery to the site, or during the progress of the Work, if the Owner's Representative finds that plants do not meet the requirements of the PLANT LIST or this Contract, have declined noticeably due to handling abuse, lack of maintenance, or other causes. Cost of replacements, as required, shall be borne by the Contractor.

G. Placement of Loam for planting soil shall be specified, performed, and paid for under the Work of Section, Planting Soils. Obtain Owner's Representatives written approval of Work of rough grading and finish grading prior to starting the Work of planting.

H. Planting:

1. Notify the Owner's Representative three Working days prior to the proposed arrival of plant material on the site. If not planted within 24 hours of delivery to the site, all plants shall be maintained in an on-site nursery. Container grown shrubs stored on site shall be shaded from direct sunlight at all times and shall not be stored directly on paved surfaces. All plants delivered to the site and not planted within 24 hours of delivery shall have their root balls covered with mulch and shall be watered on a daily basis such that root balls are kept moist throughout.
2. Locations for all plants and outlines for planting areas shall be staked on the ground by the Contractor for approval by the Owner's Representative before any plant pits or plant beds are dug. Notify the Owner's Representative no less than 3 days prior to the desired date of inspection of staking to schedule site visit.

3. All plant pits dug with a machine shall have the sides of the holes scraped with hand shovels to prevent glazing or compaction of the sides of the hole. Remove and stockpile excavated loam for reuse as backfill for plant pit. All subsoil excavated from the bottoms of planting pits shall be removed from the site.
4. All plant pits shall be hand dug. All subsoil excavated from the bottoms of planting pits shall be removed from the site.
5. Plant pits shall be dug to the dimensions shown on the Contract Documents.

    a. Plant pits for trees shall be a minimum two times greater in diameter than the diameter of the root ball. Place root ball directly on subgrade. Slope sides of tree pits at a 45 degree angle.
    b. Plant beds for shrub massing shall be one large and continuous excavated bed. Extend bed no less than 3 feet beyond limits of shrub root balls on perimeter of bed.
    c. Plant pits for trees and shrubs shall be dug to the depth of the rootball to be planted.
    d. Remove all soil from around the root flare of the stem of the plant and from the top of the rootball to determine the true depth of the rootball. All plants that have been planted and have root flares that are buried will be rejected.

6. Groundcover, Bulb, and Perennial Beds:

    a. Groundcover, bulb and perennial beds shall be dug to a continuous depth of 1 foot below final grade, or as shown on the Contract Documents and replace with sufficient planting soil mix. Remove groundcover and perennials from their pots immediately before planting. Handle plants carefully to prevent damaging roots. Place each plant in individual hole and firm the planting mix around the roots. Water thoroughly and mulch. Groundcover plants may be planted after the planting mulch is placed.
    b. Bulbs shall be planted at depths as recommended by bulb supplier, as shown on the Contract Documents, or both. Bone meal shall be applied at the rate of 1/2 pound to every 25 square feet of area of bulbs. Bulbs shall have bone meal added as they are planted.

7. All plant roots and earth balls must be damp and thoroughly protected from sun and wind from the beginning of the digging operation, during transportation, and at the site until the final planting.
8. Remove container plants from containers prior to planting.
9. Trees and shrubs shall be placed in the center of plant pits, plumb, with the crown of their roots exposed and located above the surrounding finish grade.
10. Prior to completion of planting installations, remove rope and cut wire baskets from the top 1/3 of the root balls. Pull burlap away from the trunk or stem of the plant and cut burlap from the top 1/3 of the root balls.
11. Contractor shall 'butterfly' the root system for all container grown perennials immediately prior to planting them. Butterflying shall consist of vertically cutting the containerized root ball with a spade through the bottom half of the rootball followed by gently pulling the rootball open at the cut while placing it into the planting hole. The butterflied root system shall be placed over a small ridge of soil in the planting pit in order to assure as much soil to root ball contact as possible and to keep the halves apart.

12. Planting soil shall be backfilled with approved planting soil to the full depth of the planting pit or bed. Eliminate air pockets and compact the soil by flooding the tree pit or plant bed within 2 hours of planting installation. After water has drained from the planting pit or bed and planting backfill has dried enough additional planting soil shall be spread in pit or bed to bring the finished surface of the planting pit or bed to grades shown on the Contract Documents. A saucer shall be formed around each plant at a depth of 3 inches for trees and for shrubs.
13. Fertilizer shall be spread over the plant saucer or plant bed between the saucer and the edge of the rootball and till the fertilizer into the soil to a depth of four inches prior to the placement of the planting mulch. Fertilizer shall be provided, spread and paid for under Section, Planting Soils. Do not mulch until placement of the fertilizer has been verified by the Owner's Representative. Fertilizer application rates shall be as determined by soil testing, analysis, and testing laboratory recommendations specified, performed and paid for under Section: Planting Soils.
14. All plants shall be inoculated with mycorrhizal fungi. Inoculant shall be added after the plants have been placed in their holes. Open the required number of packets for each plant and thoroughly mix the inoculant powder into the upper 10 inches of backfill soil.

    a. Mycorrhizal fungal inoculant shall be added to the plant pits according to plant size.
    b. The application rates for mycorrhizal fungal packets shall be in accordance with the manufacturer's recommendations.
    c. Submit the purchasing receipt showing the total quantity purchased for the Project prior to installation. Submit empty packets of fungal spore inoculant to the Owner's Representative for verification of use. Owner's Representative will excavate tree pits to determine presence of mycorrhizal fungal inoculant.

15. Tree staking shall be provided as shown on the contract documents.

I. All plants shall be watered immediately following planting as necessary to thoroughly moisten rootball and plant pit loam and thereafter shall be inspected frequently for watering needs and watered, as required, to provide adequate moisture in the planting pit. The Contractor shall inspect tree pits 24 hours after initial watering to confirm that they are draining properly. If surface water or excessively saturated plant pit soils exist, the Contractor shall immediately notify the Owner's Representative. The Owner's Representative will recommend remedial measures based upon site conditions.

J. Keeping Trees Plumb:

1. Contractor shall keep trees plumb and upright at all times. To this end the Contractor shall monitor plants on a regular basis and, if a tree is moved out of plumb, then straighten the tree to a vertical, upright condition.
2. Reset trees that have moved out of plumb by carefully excavating the soil from the base of the rootball facing away from the direction of tilt and easing the tree upright into a vertical, plump position. Upon righting the tree, firmly press the soil around the base of the rootball to reset the tree.

K. Mulch material shall be placed over entire saucer areas of individual trees and shrubs and over the entire area of planting beds to a depth of 3 inches after settlement, not later than one week

after planting. Do not apply mulch prior to the first watering of plant materials. Do not apply mulch prior to placement of surface applied fertilizer and verification of placement by the Owner's Representative.

L. Pruning:

1. As directed by the Owner's Representative, each plant shall be pruned in accordance with the Workmanship requirements of "Pruning Standards" for Class I, fine pruning, to preserve the natural character of the plant.
2. Tree pruning, as required, shall be undertaken to the full height of affected trees.
3. All dead wood or suckers and all broken or badly bruised branches shall be removed. Never cut a leader.

M. Antidesiccant shall be applied to all evergreen and broadleaf evergreen plants in that are planted during the fall season if planted after Nov. 1 according to manufacturer's application recommendations and as directed by the Owner's Representative.

N. Spraying of insecticides or herbicides shall be done by State-licensed professionals. Spraying for insects, pests and diseases shall conform to the National Arborist Association Standards under the section entitled "Standards for Pesticide Application Operations", as currently adopted and as approved by the Owner's Representative. All insecticides, pesticides, and herbicides shall be EPA-approved.

O. If planting is done after lawn preparation or installation, proper protection of lawn areas shall be provided. Any damage resulting from planting operations shall be repaired immediately at no cost to the Owner.

P. In the event that rock or underground construction or obstructions are encountered in any plant pit or bed excavation work, alternate locations will be selected by the Owner's Representative. Relocation of plant pits or beds shall be provided at no additional cost to the Owner. Provide the Owner's Representative with no less than 48 hours notice of obstruction so that a site visit can be scheduled to establish new locations for plants.

Q. Absolutely no debris may be left on the site. Repair any damage to site as directed by the Owner's Representative, at no additional cost.

3.2 MAINTENANCE

A. Maintenance shall begin immediately after each plant is planted and shall continue for a minimum 60-day Monitoring Period and until Final Acceptance of the project.

B. Maintenance shall consist of keeping the plants in a healthy growing condition and shall include, but is not limited to watering, weeding, cultivating, pruning, re-mulching, straightening of trees to, a plumb position, removal of dead material, resetting plants to proper grades or upright position, and maintaining the planting saucer.

C. Plants shall be inspected for watering needs at least twice each week and watered to promote plant growth and vitality. The following watering rates assume that the soil is free draining. If

the on site conditions do not ensure a free draining soil, then notify the Owner's Representative in writing of this condition. Watering rates for trees, shrubs, ground cover, vines and perennials in free draining soils are presented here as guidelines to ensure that the top six inches of plant bed soil remains moist at all times. Actual watering rates may vary depending upon soil conditions.

1. For trees in lawn or mulched beds, apply water to the ground surface directly under the canopy. Water shall be applied at a sufficiently slow rate to prevent run off from the soil surface, but great enough to equal 0.2 inches of water per square foot of canopy area per hour for 5 hours per week.
2. Planting beds and individual plant pits shall be kept free of weeds, and mulch shall be replaced as required to maintain the specified layer of mulch. Beds and individual pits shall be neat in appearance and maintained to the designed layout.
3. Plants that die during the maintenance period shall be removed and replaced by the Contractor within one week of notification and replaced during that growing season, unless directed otherwise by the Owner's Representative.
4. Work of pruning, fertilizing, spraying, and similar activities shall be undertaken only by Certified Arborists and licensed chemical applicators, as pertinent to the Work being performed.

D. During the maintenance period, any decline in the condition of plantings shall require the Contractor to take immediate action to identify potential problems and undertake corrective measures. If required, the Contractor shall engage professional arborists and/or horticulturalists to inspect plant materials and to identify problems and recommend corrective procedures. The Owner's Representative shall be immediately advised of such actions. Inspection and recommendation reports shall be submitted to the Owner's Representative.

3.3 ACCEPTANCE

A. Upon completion of all planting Work, the Contractor shall request in writing that the Owner's Representative formally inspect the planting Work.

B. If plant materials and Workmanship are acceptable, the Owner's Representative will issue a written Certificate of Conditional Acceptance to the Contractor.

C. Following the issuance of the Certificate of Conditional Acceptance to the Contractor, the Contractor shall maintain the plants for a minimum 30 day Monitoring Period. At the end of the Monitoring Period, the plant material will be inspected by the Owner's Representative to determine whether or not all planting Work has been performed to the requirements of this Section.

D. Acceptance Standards at end of the Monitoring Period: If plant material is reviewed when it is in full leaf, leaves shall be plump with water with a shape indicative of the species and shall be free of insect, pest and disease damage. Twigs shall have living cambium for their full length. Twigs and branches shall have a full bud set for their full length, including terminal buds. Trunks and branches shall be free of frost cracks; sun scald; damage due to insects, pests, and disease; structural defects; and damage resulting from machinery or tools. Plant material inspected and reviewed when the plants are not in full leaf shall have twigs, branches and trunks

meeting the above requirements. All plants regardless of the season of review shall have a minimum of 75 percent healthy, balanced branching structure with a healthy terminal leader(s) with viable terminal bud(s).

E. If any numbers of plants do not meet these Acceptance Standards at the time of inspection or if in the Owner's Representative's opinion workmanship is unacceptable, written notice will be given by the Owner's Representative to the Contractor in the form of a punch list, which itemizes necessary planting replacements and/or other deficiencies to be remedied. The Contractor's responsibility for maintenance of all plants shall be extended until replacements are made or other deficiencies are corrected. All plants that do not meet these Acceptance Standards shall be removed from the Project within seven days of receipt of the punch list. Replacements shall conform in all respects to the Specifications for new plants and shall be planted in the same manner.

F. Following the correction of all Punch List deficiencies, the Contractor shall request in writing that the Owner's Representative formally inspect the planting Work. If plant materials and workmanship are acceptable, the Owner's Representative will issue a written Certificate of Final Acceptance to the Contractor.

3.4 GUARANTEE

A. The date of the Certificate of Final Acceptance shall establish the beginning of the maintenance period and the commencement of the required two-year guarantee and establishment period for planting Work.

B. At the end of the guarantee and establishment period, a final inspection will be held to determine whether any plant material replacements are required. Each plant shall be plumb, shall have a character that is natural for its species as determined by the Owner's Representative, and shall conform to the Acceptance Standards described in this Section. Plants found to be unacceptable shall be removed promptly from the site and replaced according to this Section. A final inspection will be made after the replacement plants have lived through one year.

C. All replacements shall be plants of the same kind and size specified in the PLANT LIST. The cost shall be borne by the Contractor, except for possible replacements due to vandalism or neglect on the part of others.

END OF SECTION 329300

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SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SUMMARY OF WORK

A. Furnish all labor, materials, tools, equipment and related items required to install a subdrain system as shown on the Contract Documents.

B. Section Includes:

1. Subdrainage system below Synthetic Turf areas.

1.2 RELATED WORK IN OTHER SECTIONS

A. The following Sections have Work related to this Section:

1. Section 033000 – Cast In-Place Concrete.
2. Section 312000 – Earth Moving
3. Section 334600 – Sub-Drainage

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data, including installation instructions.

B. Shop Contract Documents: Submit manufacturer's shop Contract Documents, indicating layout, dimensions, materials, components, and accessories.

C. Samples: Submit manufacturer’s sample of drainage bundle with drain pipe.

D. Manufacturer’s Certification: Submit manufacturer’s certification that materials comply with specified requirements and are suitable for intended application.

E. Warranty Documentation: Submit manufacturer’s standard warranty.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Manufacturer regularly engaged, for a minimum of 10 years, in the manufacturing of subdrainage systems of similar type to that specified.

B. Installer's Qualifications:

1. Installer regularly engaged, for a minimum of 5 years, in installation of subdrainage systems of similar type to that specified.

2. Employ persons trained for installation of subdrainage systems.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery Requirements: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage and Handling Requirements:

1. Store and handle materials in accordance with manufacturer's instructions.
2. Keep materials in manufacturer's original, unopened containers and packaging until installation.
3. Store materials in clean areas, protected from exposure to harmful weather conditions.
4. Store materials out of direct sunlight.
5. Protect materials during storage, handling, and installation to prevent damage.

1.6 AMBIENT CONDITIONS

A. During Cold Weather:

1. Do not use frozen materials.
2. Do not use materials mixed or coated with ice or frost.
3. Do not build on frozen Work.
4. During Wet Weather: Do not build on wet, saturated, or muddy subgrade.

PART 2 - PRODUCTS

2.1 UNDERDRAINS

A. Underdrain system shall be Mutli-Flow Drainage Systems as manufactured by Varicore Technologies, Inc. P.O. Box 131, Prinsburg, MN 56281, Phone 800-978-8007, or an approved equal.

B. The underdrain conduit shall be 18 inch flexible, prefabricated, rounded rectangular shaped, composite product. The drain conduit shall be wrapped with a non-woven geotextile. This non-woven wrap shall be of a needle-punched construction consisting of long-chain polymeric fibers composed of polypropylene, polyethylene or polyamide. The fibers shall be oriented into a multi-directional stable network whereby they retain their positions relative with each other and allow the passage of water as specified. The fabric shall be free of any chemical treatment or coating, which reduces permeability and shall be inert to chemicals commonly found in soil.

C. The drainage core shall be made of a high-density polyethylene. The core shall be constructed using interconnected corrugated pipes that define and provide the flow channels and structural integrity of the drain. The geotextile shall function only as a filter

Pipe for edge drain outlet laterals shall be either PVC pipe meeting the requirements of ASTM D 2729 or ASTM F 949, or high-density polyethylene pipe meeting the requirements of AASHTO M 252.

D. The fittings used with the edge drain shall be of a snap together design. In no case shall any drainage product be joined without the use of the Manufacturers connector designed specifically for the purpose. Provide all connectors and adapters as necessary to complete the drainage system.

E. A rodent screen made of 0.3 inch by 0.3 inch square opening size, 0.063 inch gauge, stainless steel or galvanized, welded wire mesh shall be installed in each outlet lateral line. When using galvanized welded wire mesh, the rodent screen shall be galvanized after it has been formed to the shape and dimensions shown on the Construction Documents or specified by the Owner's Representative.

F. Underdrain Outlets:

1. Concrete for patching shall be 3000 p.s.i.as specified in Section 033000 – Cast-In-Place Concrete.

2. Precast concrete end walls shall be 12 inches dia. flared end outlet with apron, 4000 PSI at 28 days with 5.5% A.E. Reinforcement shall comply with ASTM A615 Grade 60.

2.2 SAND DRAINAGE LAYER

A. Sand layer to cover the underdrainage pipe in the trench shall be hard, clean, durable sand compatible for use as a drainage material. The particle size shall be defined as less than 5 percent retained on a No. 10 screen, and less than 5 percent passing through a No. 30 screen. No more than 1 percent shall pass a No. 50 screen.

2.3 FILTER FABRIC

A. The filter fabric shall be used to separate the sand blanked from the backfill or topsoil on all sides. The fabric shall be AMOCO 4545 or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive subdrainage system.

B. Notify Owner's Representative of conditions that would adversely affect installation or subsequent use.

C. Do not begin installation until unacceptable conditions are corrected.

3.2 PREPARATION

A. Excavate trenches as indicated on the Contract Documents to widths and depths to accommodate subdrainage system.

B. Slope trenches as indicated on the Contract Documents to flow toward outlets.

C. Prepare and shape smooth trench bottom to have continuous contact with drainage bundles at elevations indicated on the Contract Documents.

D. Ensure trenches are free of debris.

E. Inspect drainage bundles for dirt, debris, and foreign objects before installation.

3.3 INSTALLATION

A. Underdrain Pipe Installation: The underdrain pipe shall be laid horizontal at the bottom of the trench and the pipe sections joined securely with the appropriate coupling fittings or bands, or other necessary connections per the Manufacturer's recommendations to provide a complete drainage system connected to precast concrete outlets. The upgrade end of pipe installations shall be closed with suitable plugs to prevent entry of soil materials. The pipe shall be installed in such a manner that continuous outflow is provided during construction. The drainage system shall be laid at a minimum of 1 percent slope to drain outlets. Any pipe that is damaged, crushed, or not lain properly shall be removed and replaced at the direction of the Owner's Representative with no additional cost to the Owner.

B. Underdrain Outlet Protectors: The foundation shall be prepared to the required depth, forms set rigidly to the line and grade designated, and the concrete placed, spaded, vibrated, and finished with a wood float to a true and even surface. When completed, the concrete shall be cured as specified in Section 033000 – Cast-In-Place Concrete. Precast units shall be placed on a foundation prepared to the proper depth and the pipe underdrain shall be firmly secured to the outlet protector. The outlet protector shall be placed in such a manner that the underdrain lateral has a uniform slope to ensure proper drainage. Abrupt changes in slope along any portion of the lateral will not be permitted.

C. Sand Drainage Layer: After the underdrain pipe installation has been inspected and approved by the Owner's Representative, sand material shall be placed in a layer to a minimum height of 3 inches above the top of the pipe, surrounding the pipe in a blanket layer that is the full width of the trench.

D. Filter Fabric: The filter fabric shall be installed as shown on the Construction Documents. Care shall be taken during the placement of the planting soil, to prevent damage to the fabric and underdrain.

E. Protection: The Contractor shall protect the underdrain from contamination prior to the placement of successive courses. Underdrains contaminated or crushed are subject to removal and replacement at no cost to the Owner.

3.4 ADJUSTING

A. Remove and replace with new material, damaged components that cannot be successfully repaired.

3.5 CLEANING

A. Clean subdrainage system of accumulated dirt, debris, and foreign objects before final project completion.

3.6 PROTECTION

A. Protect Work of this Section to ensure that Work will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 329300